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EDITORIAL.

Reconstruction of the Malayan Pineapple Industry.

Among the established agricultural industries in Malaya, which incurred loss and damage as a result of the war, the pineapple industry has suffered no less than any other. On the planting side, the main planted areas reverted to rolling wastes of lalang grass, and in 1946 out of the 40,000 acres of pineapples grown as a sole crop only a few large areas on peat, amounting to about 6,000 acres in Selangor and South Johore, remained. These areas, although overgrown with weeds were found to be capable of resuscitation and, along with a few hundred acres of new plantations, in the Pontian district of Johore established towards the end of the occupation period, comprise all that is now left of the former, flourishing plantation industry.

On the canning side in 1946 out of seventeen pre-war canneries only one was intact, two had been completely destroyed, five had become derelict from neglect, and nine had sustained varying degrees of damage.

From 1930 onwards, developments in the cultivation and canning of pineapples in Malaya were considerable, and, whereas the crop was formerly grown mainly as a catch crop with young rubber, by 1941 about two-thirds of the total area, which exceeded 60,000 acres, was under pineapples as a sole crop.

In the early days of the industry the canned fruit obtained a ready market, but, with extension of pineapple canning in other countries and competition from a wide range of other canned fruits, it became necessary to reorganise the industry on modern lines. Finally a " Central Board of Pineapple Packers and Growers Association " was formed in 1939, by which time considerable improvements in canning methods had occurred, market grades were introduced and re-equipment of the factories with the most up-to-date machinery was contemplated and the re-organisation, supported by legal authority, had given the industry valuable support which, it was hoped, would place it on a sound basis.

Mr. C. E. Courtenay, who had considerable pre-war experience on the commercial side of the Malayan industry, has now been engaged by Government to advise on reconstruction, and Mr. F. C. Cooke, A.R.C.S., B.SC., A.M.I.CHEM.E., of the Department of Agriculture, has been appointed Canning Officer at the former pineapple Canning Research Station, Johore Bahru, to work and advise on research in manufacturing problems. A

committee was appointed in May 1947 under the chairmanship of the State Agricultural Officer, Johore, and is engaged in drawing up detailed plans for the immediate and long-term development of the industry. Departmental activity has also begun in connection with cultural problems and post-war reconstruction is now well under way.

The article by Mr. Courtenay, published in this issue of the Journal, forms the first of a series, which will be published from time to time, on the measures undertaken to bring about this rehabilitation. Mr. Courtenay points out that the task confronting the industry is not one of re-establishment on the pre-war basis, but of reconstruction according to a new design in which little of the former structure can be incorporated.

China Tea. Commercial production of Malayan tea commenced about 1927 and, by 1940, production of made tea from estates was approaching 1,600,000 lbs. of which more than half was sold locally, Imports of " Green " and " China " tea from China, for local consumption, amounted to between one and two million lbs. in pre-war years and consisted of both expensive, high-quality grades and cheap grades suited to the needs of the poorer sections of the local, Chinese population. Although the terms " China " tea and " Green " tea are commonly regarded as being synonymous, there is a distinct difference between the teas, in that, in the manufacture of China tea, a limited but controlled fermentation of the leaf is permitted whereas, in the case of green tea, the fresh leaf is steam-heated in order to destroy the enzymes of fermentation.

Experiments in the manufacture of green and China teas from Assam, Manipuri and China jats, growing at the Central Experiment Station, Serdang, were conducted in 1940-41. The results of these experiments are recorded in the article now published in this Journal and it is shown that high yields of green and China teas from Assam and Manipuri jats can be obtained and processed, and that the China tea can be placed on the local market to sell at competitive prices with similar grades of imported teas.

The green, or steamed tea, was not marketed locally or in London and its commercial possibilities need further investigation. Malayan black tea has always obtained a ready sale, both locally and on the London market, and these experiments at Serdang have shown how China tea can be manufactured locally not only by hand but also by the partial use of machinery normally employed in the manufacture of black tea.

Cattle in Malaya. The second in the series of articles, relating to animal husbandry in Malaya, appears in this issue of the Journal. The authors describe, the types of cattle kept in this country by Indian dairymen, labour forces, the local peasantry and by farms on the hill Stations and in the neighbourhood of large towns, where in the past small herds of cattle of European origin were maintained.

Native methods of feeding livestock are still primitive, pasture is inadequate and supplementary concentrates are provided in insufficient quantity. Herd management and controlled breeding are not practised

intelligently, and there is need for considerable improvement in all aspects of local animal husbandry in order to check the gradual deterioration in the quality of the cattle, particularly of the Indian breeds.

Practical measures, which could be adopted by local cattlemen to upgrade their stock, are discussed in the article and it is considered that elementary, selective breeding, within the existing herds, possibly in conjunction with the importation of good quality bulls from India, merits consideration as a first step in the improvement of the stock.

Advisory Service for Rubber Small-Holders.

In 1934 a " Small Holders Advisory Service " was established, by the Rubber Research Institute of Malaya, in order that the results of investigations conducted by the Institute should be made available to the small-holder. Asiatic Rubber Instructors, Malay, Chinese and Indian are attached to the Agricultural Offices in the districts to which they are posted and they work under the supervision of the Agricultural Officers in charge of these districts.

In 1941 the S.H.A.S. consisted of 41 Instructors and 20 Demonstrators and was directed by a full-time, Advisory Officer of the Rubber Research Institute. Many important improvements in care of the trees and in quality of the product were brought about and it was shown that, with proper guidance and assistance, the small-holder is fully capable of taking advantage of these improvements in methods which are applicable to his own circumstances.

Every effort is now being made by the Institute to re-establish this service and to increase its scope. The Staff is not yet up to full strength, but is being recruited as officers trained at the College of Agriculture, Malaya, become available.

A list of Instructors is published in the article dealing with the S.H.A.S. included in the present number of this Journal. The services of these officers can always be obtained, free of charge, on application to the appropriate Agricultural Office or direct to the Rubber Research Institute.

Original Articles.

THE RECONSTRUCTION OF THE MALAYAN CANNED PINEAPPLE INDUSTRY

I. The Pre-war Industry and the Problem of Post-war Reconstruction

BY

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In the series of articles to which this is introductory, it is proposed to give an account of the measures which are being taken to reconstruct the Malayan Canned Pineapple Industry after the devastation of the war years, and, in particular, to review the work of the Johore Pineapple Committee (or, to give it its full name, the "Resuscitation of the Malayan Pineapple Industry, Johore Committee) which, since May of this year, has been engaged in drawing up detailed plans for the immediate and long term development of the industry. Action has been taken, or is in process of being taken, on those of the Committee's recommendations which bear on the immediate task of getting the industry re-started with the minimum of delay, but, at the time of writing, the Committee has still to consider some important aspects of long term policy, and until it has formulated its recommendations on these matters and decisions thereon have been taken by Government, it will be premature to attempt a balanced account of its work.

But in the meantime it will be of interest to examine the historical background of the problems with which the Committee is dealing, as it is only by reference to the past history of the industry that the validity of the plans for its reconstruction can be properly assessed.

The Pre-war Industry.

During the period of 40 years prior to the last war, the canning of pineapple in Malaya developed from a small shop-house industry to become one of the largest single fruit-canning industries in the world. In 1937 which is the last pre-war year for which complete world figures are available, Malaya supplied the U.K. with 90% of its imports of canned pineapple and 25% of its imports of all canned fruits. The Malayan pack at 2½ million cases accounted for 27% of the world production of canned pineapple and 80% of the world export trade in this commodity.

But the picture of a well-established, prosperous industry which these figures seem to depict was largely illusory. The industry during its period of greatest expansion, in the 1920's and early 1930's, had depended for its fruit supplies almost entirely on pineapples grown as a catch crop on land newly opened for rubber planting. With the introduction of the Rubber

Restriction Scheme in 1931, packers were faced with a rapid shrinkage of supplies from this source and during the 4 or 5 succeeding years large areas of hilly and undulating jungle land were opened up in South Johore for the planting of pineapples as a sole crop. Unfortunately this new planting movement lacked proper co-ordination and control, the fugitive and unscientific methods of " catch crop " cultivation were perpetuated, and within a few years after planting most of these areas had suffered so badly from soil degradation and erosion as to have become useless for permanent cultivation.

The fact is that the change from " catch crop " to " sole crop " cultivation, to be successfully accomplished, called for a re-organization of the whole structure of the industry. Hitherto the expanding export trade had been built up on the basis of low price rather than sound quality. Malayan canned pineapple was the cheapest canned fruit of commerce, its price being normally less than half that of pineapple from other sources and 30% to 40% lower than the prices of competitive canned fruits such as pears, apricots and peaches. Low production costs had been made possible by catch crop methods of cultivation, cheap factory labour, and adherence to primitive methods of canning which involved a minimum of capital expenditure on plant and machinery. The establishment of the pineapple as a permanent plantation crop would necessarily have involved a substantial increase in the cost of fruit production, but the increase in the sale price of the canned product thus necessitated would still have left the Malayan packer in a strong competitive position on a price basis, and if the rise in price had been accompanied by an improvement in quality the effect upon the export trade would probably have been beneficial rather than the reverse. A change of this nature could be effected only by centralised co-ordination and control of planting, packing and marketing, but at this critical stage in its history, those engaged in the industry failed to appreciate the need for co-operative action, and it was not until 1938-39 that, with the formation of the Central Board of Pineapple Packers, a belated attempt was made to re-organize the industry to meet the new conditions with which it was faced. But before considering the reforms which were carried out by this body, it is necessary to describe in more detail the conditions which obtained in the industry prior to its formation.

Reference has already been made to the low quality standard of the Malayan pack. This was in part attributable to primitive methods of processing and inadequate supervision in the canneries, but the basic cause was the lack of organization in the plantation side of the industry and the inefficient methods of harvesting and marketing the crop. With few exceptions, packers had no control over the cultivation of fruit and no direct contact with the fruit growers. Much of the cultivation was carried out by small-holders from whom the fruit was bought by middlemen who transported it from the plantations and re-sold to the canneries. The small-holders were mostly in the clutches of moneylenders who, having

financed them during the period taken to open up their land and bring it into bearing, subsequently levied a toll (usually 30%) on all crops produced. The small-holder was also subject to exploitation by the middleman who constituted the sole means of marketing his crop. As a rule his net receipts amounted to little more than half the price paid by the canner, and provided barely enough for his subsistence, leaving no margin to finance proper methods of cultivation.

In the absence of any effective organization of growers, packers were unable to make long term contracts for the purchase of fruit, and they competed for supplies from day to day. Prices were therefore subject to constant, and often violent, fluctuations and these fluctuations had a marked effect upon the quality of the fruit delivered at the canneries. When prices were high, growers were apt to harvest as many pineapples as possible of the minimum size, whether ripe or not, in an attempt to cash in on their crops while the going was good, whereas when prices were low they would retard harvesting in the hope that the market would improve. Thus, during high price periods much of the fruit received at the canneries was immature, and during low price periods a considerable percentage of the fruit would be over-ripe.

A further factor which adversely affected the quality of the fruit delivered at canneries was the impoverished condition of the growers, who were often so pressed for funds that (particularly during the early parts of the seasons) they accelerated harvesting and cropped their fruit long before it was fully ripe. Also many of the holdings were too small for efficient harvesting. To obtain uniformly ripe fruit, pineapple plantations should be harvested at 3 to 5 day intervals during the fruiting seasons, but in the case of small plantations of 5 to 20 acres, such frequent cropping does not yield saleable quantities, and harvesting is usually carried out at longer intervals, up to 10 days or 2 weeks. This means that the grower, in order to avoid wastage, must harvest, not only the ripe fruit but also such fruit as he judges would become over-ripe if left until the next harvesting period.

It will be recognised that with these methods of cultivating, harvesting and marketing the fruit crop it was impossible for the industry to maintain regular and satisfactory standards in the grading of the pack, but, in addition, the production methods employed in the canneries were primitive and, judged by modern standards, inefficient. The cutting of the fruit was performed entirely by hand, and, although the Chinese operatives attained a remarkably high standard of speed and skill, the results could not compete in uniformity with the machine-cut packs of the Hawaiian and Australian pineapple industries. The grading of the cut fruit was often inadequately supervised, but it was in their method of processing the pack that Malayan packers lagged farthest behind their competitors.

Typically, a modern fruit-processing line consists of a Syruping machine, an Exhauster, a Can-closing machine and an Automatic Cooker

and Cooler. All the machines in the line have the same rate of output, the cans pass from one to the other and the whole process is continuous and automatic. The can containing the cut fruit first enters the Syruping machine, in which it is filled with syrup to the required level, and is then passed to the Exhauster in which its contents are gradually raised to a temperature of about 180 degrees F. The purpose of this operation is to expel the gasses dissolved in the juice of the fruit and to allow the fruit cells to expand without bursting. Also, when on emergence from the Exhauster, the can is closed, the water vapour rising from the surface of the syrup excludes the air, creating a vacuum in the closed can, thus preventing deterioration of flavour due to oxidation. The vacuum in the can serves to keep the ends of the can concave, and in the case of an " exhausted " pack, a bulged lid invariably indicates that the contents have become contaminated and fermentation has set in. Faulty cans can thus be readily detected by external inspection. After the cans have been exhausted and closed, they enter the Cooker in which they are cooked at a controlled temperature for a period accurately regulated to give the best result with the particular type of fruit being processed. From the Cooker the cans are passed to the Cooler in which their temperature is reduced to a point low enough to obviate a " secondary cook."

In Malayan canneries the exhaust process was omitted altogether. The cans, having been filled with cut fruit and syrup, were closed cold and then immersed in open vats containing water which was brought to boiling point by the injection of steam. The time of cooking was controlled only within very approximate limits, and after removal from the vats the cans were stacked honey-comb fashion and left to cool. The omission of the exhaust process not only adversely affected the appearance and flavour of the canned product, but was responsible for the prevalence of bulged lids which was a constant source of trouble with buyers and constituted a serious obstacle to the development of trade in some overseas markets. The pineapple, unlike many other canned fruits of commerce, is not readily susceptible to spoilage from over cooking, and the lack of accurate control of this operation in Malayan canneries and the secondary cook which took place during the cooling process, did not very seriously affect the quality of the pack, although contributing to some extent to the lack of uniformity in the final product.

The cans used in Malayan canneries were of the " hand-made " type, and each cannery manufactured its own supplies. This constituted a major obstacle to the mechanization of cannery operations, for this type of can is not suitable for use in conjunction with modern processing machinery such as has been described above. To work this machinery at or near maximum efficiency, machine-made cans must be used, as the requisite standards of uniformity of size and shape are unattainable by manual methods of can manufacture. But can-making by modern methods is a highly specialised industry. The plant required is costly, its operation calls

for a high degree of technical skill, and the volume of output of an economic unit is in excess of the needs of any except the very largest canneries. For these reasons, other important fruit-canning industries in all parts of the world had long since abandoned the practice of manufacturing the cans at the canning plants, and this operation had been centralized in large units from which canners obtained their supplies of cans ready for use. The more progressive of the Malayan canners recognised the desirability of a similar centralization of their can-making, as a first step in the modernisation of their canning methods, but they failed to achieve the measure of co-operation necessary to put a scheme of this kind into effect.

The failure to carry out this and other essential reforms on the basis of voluntary co-operation was largely due to the inclusion in the industry of a number of canners who had no permanent stake in its prosperity, were interested in it only as a source of quick profits, and who opposed any long term schemes for improvement which would entail an increase in their capital investment. In the conditions then prevailing, the erection and equipment of a cannery called for a comparatively small outlay, its operation demanded little technical skill, and as ample fruit supplies were available in the open market, the owner was under no necessity to establish his own plantations. Thus, during every period of prosperity, there was an outcrop of small, under-capitalised canneries constructed at the minimum of cost and operated on lines of irresponsible speculation which not infrequently ended in bankruptcy.

The unstable structure of the industry, and the violent fluctuations in production costs arising from the day to day competition for fruit supplies, rendered impossible an orderly disposal of the pack at fixed prices, and the marketing of the pack was characterised by speculative methods on the part of both packers and exporters. Forward sales in the early parts of the seasons were based, not on current costs, but on estimates (or guesses) as to the relation between supply and demand during the packing months, and the reaction of these factors on the price of fruit. This method of marketing resulted in erratic price movements, and even when market conditions were favourable, speculative selling and unregulated competition amongst packers often forced prices down to a level much below that which consuming markets would have been willing to pay.

But in spite of its defects, the industry enjoyed a considerable measure of prosperity until the early 1930's, when rapidly increasing fruit production coincided with depressed conditions in the world canned fruit markets. It was then that the dependence of the industry on low price rather than sound quality, and its failure to evolve any coherent organization to control production or to regulate marketing, had their effect, and although in a period of 7 years, annual exports were increased by 70%, this was only achieved by a progressive lowering of the price level which, in turn, led to a deterioration of conditions on both canning and planting sides of the industry.

In 1934, Government decided to bring the industry under legislative control in order to enable the enforcement of reforms, which, it was now apparent, were necessary for its survival. Accordingly the Pineapple Industry Ordinance was enacted, conferring on Government very wide powers for the regulation of the Industry. Under this Ordinance, Registrars of Pineapple Canneries were appointed with whom packers were required to register their canneries. The packing of pineapple without registration was made an offence, and regulations were promulgated setting out the conditions with which packers must comply to qualify for registration. The Registrar had power to refuse registration if these conditions were not complied with or if, in his opinion, the number of canneries already registered was sufficient for the requirements of the industry.

The first regulations made under the Ordinance were concerned with an improvement in the sanitary conditions at the canneries. It was intended to proceed with other regulations to enforce improved processing methods, but action was postponed at the request of the packers who maintained that economic conditions in the industry must be established on a sounder basis before it would be possible to raise the capital required to carry out these reforms.

The most important result of the enactment of the Ordinance was that by providing the means to control the activities of the less responsible packers, it created conditions favourable for the formation of a representative packers' association. Such an association was formed in 1938 under the title of "The Central Board of Pineapple Packers, Malaya." At the time the Board was formed, the industry was heading for bankruptcy. For many months past the price of a case of canned pineapple containing forty-eight 1½-lb. cans had remained at about $2.60, or about 5½ cents for a can containing the edible part of one and a half pineapples plus 3 ozs. of sugar. The price of fruit had fluctuated between 70 cents and $1.50 per 100 delivered to the cannery; and, in the more remote areas, crops were being left to rot in the fields.

In these circumstances the first concern of the Board was to establish a higher price level for the pack by controlling production on a quota basis, and centralising the sale of canned pineapple in the hands of its Trade Committee, and by these means it effected a rise of about 30% in the price level in the space of about 9 months. In order to consolidate its position, the Board sought Government recognition as the Association representative of the canning side of the industry. This was conceded and membership of the Board was made a condition of registration under the Ordinance. In return, the Board undertook to co-operate with Government in carrying out the aims and objects of the Pineapple Industry Ordinance, and in its constitution it provided for the attendance of Government Officers at its meetings, the senior of such Officers present at a meeting being given power to decide on all matters in dispute.

In addition to the improvement in the method of marketing the pack, an important reform effected by the Board was that the sale of the fruit crop was brought under some measure of control. At intervals throughout each season, meetings attended by Government Officers, members of the Central Board and representatives of the growers, were held to draw up scales of prices to be paid for the various grades of fruit. In spite of some evasion of these price agreements, a large measure of stabilization was achieved and the price of fruit was raised to a more economic level.

Thus when war broke out the industry was in process of evolving a more satisfactory organization. The operation of the Pineapple Industry Ordinance had effected a great improvement in the hygienic conditions in the canneries, and the control exercised by the Central Board over the purchase of fruit and the sale of the pack had saved the Industry from economic collapse. But no appreciable progress had been made in the modernisation of canning methods, and in the vital matter of fruit supplies the industry was dependent mainly on plantations which were rapidly deteriorating and were doomed to extinction within a few years. Exception must be made of the plantations in the Klang district of Selangor and the Pontian district of Johore, where the pineapple was being cultivated on flat, peaty land. Generally, the pineapples grown in these districts were serving as a catch crop for rubber or coconuts, but there were some areas in which it had been cultivated as a sole crop, or in association with annual food crops, for periods up to 20 years with no apparent signs of soil exhaustion. These plantations constituted the nearest approach to permanent pineapple cultivation yet achieved in Malaya.

The Occupation Period and After.

During the Japanese occupation of Malaya, pineapple canning (except spasmodically and on an insignificant scale) was discontinued, and on the British re-occupation of the country in 1945 it was found that the main planted areas in the uplands of Johore had become rolling wastes of lalang. All that remained of the plantation side of the industry were a few peat areas in Selangor and South Johore, which, although overgrown with weeds, were found to be capable of resuscitation. In addition there were a few hundred acres of new plantations in the Pontian District of Johore which had been opened up towards the end of the occupation period, and planted with Mauritius and Sarawak pineapple to supply the fresh fruit market.

Of the 17 pre-war canneries, only one had survived unscathed. Of the others, 2 had been completely destroyed, 5 had become derelict from neglect and the rest had sustained varying degrees of damage and dilapidation.

The Problem of Post-war Reconstruction.

It will be clear from the foregoing account of the past history of the industry, that the task which now confronts it is not one of re-establish-

ment on the pre-war basis, but of reconstruction according to a new design in which little of its previous structure can be incorporated.

The following summary indicates some of the more important of the problems involved, and in other articles in this series it is hoped to give an account of the proposals made for their solution.

Fruit Cultivation.

Establishment of new plantations in which the pineapple will be cultivated as a permanent crop.

Planned development of the new areas, including access roads, internal transport arrangements and drainage.

Improvement in the quality of the crop by control of cultural methods, and the selection and propagation of the most suitable varieties of fruit for canning.

Organization and control of small-holder planting.

Maintenance of a proper balance between small-holder and capitalistic cultivation.

Control of prices to be paid to growers for various grades of fruit.

Canning.

Modernization of processing methods.

Provision for supply of machine-made cans.

Establishment of standard grades of quality for canned fruit.

Elimination of the unstable, opportunist canners from the Industry.

Regulation of supplies of fruit to canneries during the transition period when canning capacity will be greatly in excess of fruit supplies.

Development of production of subsidiary products to utilize fruit now wasted at the canneries.

General Organization of the Industry.

Establishment of a Joint Control Board or similar body to provide for collaboration between all sections of the industry.

Reconstitution of the Central Board of Pineapple Packers to meet the new conditions.

Organization and control of marketing of the pack.

Drafting of legislation to give effect to the reforms outlined above.

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CHINA TEA

Manufacturing Trials at the Central Experiment Station, Serdang

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Introductory.

China tea has been a well known commodity on the London market from the beginning of the nineteenth century and was a familiar beverage in English households long before black tea was produced.

In Malaya, before tea appeared on the local market, decoctions of herbs were consumed primarily for medical purposes but also as mild stimulants; as trade developed between China and Malaya, tea was imported as a beverage to meet the needs of the Chinese community.

China tea has now become an important Malayan import as can be seen from the following abstracts from published statistics.

Net Imports of Green and China Tea into Malaya 1935 to 1940.

Year	Quantity lbs.	Value $
1935 ..	1,384,957	507,068
1936 ..	1,587,405	498,135
1937 ..	1,971,326	625,962
1938 ..	1,295,060	332,145
1939 ..	880,294	241,515
1940 ..	3,015,509	916,653

The above statistics do not differentiate between green and China tea, but the figures can be taken to represent China tea almost exclusively.

The grades of tea principally marketed in Malaya up to 1941 were as follows:—

(a) " Bohea Chui Sen ":—This tea is considered by many Chinese connoisseurs to be the highest grade tea produced. It was sold to discriminating consumers at from $2 to $12 per lb.

(b) " Thek Kwan Yin " retailed at $1.80 to $6 per lb.

(c) " Peh Moah Kew " sold at $1 to $4 per lb.

(d) Oolong (Formosan tea) sold at 50 cents to $1 per lb.

Notes on the Tea Industry in China.

The cultivation of tea in China is mostly a cottage industry; it is produced on holdings which seldom exceed ten acres and the processing is carried out by hand methods.

Cultivation and Care of Bushes.

Vegetative propagation is usually adopted by layering side branches of selected bushes; after the layers have developed roots they are lifted and transplanted in new areas or used to fill vacancies in established fields. Plucking commences two to three years after planting. The China jat unlike the improved Indian jats will flower and fruit when the bushes are in full plucking and, for this reason, it is unnecessary to establish gardens for the production of seed. On occasion seed is collected and planted direct in the field on the permanent sites of the bushes. The bushes are dormant during the winter, but as soon as growth commences in the spring heavy plucking is customary and keeps the tops of the bushes low and within easy reach of the pluckers.

The yield is low, since manuring is not practised, and it can thus be appreciated that pruning is seldom necessary. Occasionally tall bushes, particularly if they are not making new growth, are slashed, and this has a stimulating effect in promoting vegetative growth.

Thus it is evident that tea cultivation, on small holdings in China, amounts to an exploitation of the land, growth depending solely on the inherent fertility of the soil. The disparity of yields is great in comparison with those obtained under modern scientific methods of cultivation and manuring, as adopted in the production of black tea.

Plucking routine.

Owing to the marked, seasonal changes in climate, plucking cannot be undertaken during the winter. The best teas are made from the earliest pluckings in spring when growth is slow and the intervals between pluckings fairly long. About ten to sixteen plucking rounds per annum are made at intervals which vary with the season. During late spring and early summer, when growth is vigorous, the period between pluckings may be as short as five days; later in the year when growth is slower it may gradually be extended to twenty days.

The quality of tea to be manufactured will determine the methods of plucking. If high-grade tea is the objective three leaves are taken and the lowest leaf is sorted out for processing, separately, as a low-grade product, the two upper leaves being made into a better quality tea. If maximum yields are sought, coarse plucking is adopted giving a product which is sold cheaply.

Manufacture.

The leaves are processed by many different methods, resulting in teas of distinct type and quality. In all processes of manufacture, the leaves are permitted to undergo a limited fermentation which has a fundamental influence on the characteristics of the finished product. Generally the methods of manufacture, with slight modifications in detail, are as follows.

When the leaves have gone through the required withering and fermentation process, they are partially heated in shallow, iron pans and

rolled by the hands and feet and afterwards dried over a charcoal fire in bamboo trays.

To enhance the attraction of many low grade teas, exotic aromas and flavours are imparted during the process of manufacture by admixture of freshly cut, fragrant flowers. The species of flowers usually used are *Pergularia odoratissima*, (Tonkin creeper), *Jasminum sambac*, (Jasmine), *Chloranthus inconspicuus*, and *Osmanthus fragrans*.

The greater portion of the high grade teas imported into Malaya is grown in the Fukien province, which is favoured by a suitable climate and altitude for the production of quality teas. The best teas come from the Bohea mountains of the Fukien province and command very high prices.

China Tea from Formosa.

A large quantity of "Oolong" tea grown by Chinese settlers in Formosa is also shipped to the world's market, and a fair portion of this tea is imported into Malaya. In the manufacture of these teas endeavours are made, with a fair measure of success, to imitate in appearance the high-grade China teas. The Formosan teas, however, possess their own distinctive characteristics by virtue of which the teas command a place in the world's markets.

Classification of Tea.

There is some confusion concerning the classification of teas, other than the black tea now almost universally consumed. Although China tea is commonly regarded as being synonymous with green tea, there is, however, a distinct difference. In the manufacture of China tea, a limited but controlled fermentation of the leaf is permitted. This has a fundamental influence on the characteristics of the finished product, whereas the first process in the manufacture of green tea is steam sterilization of the freshly plucked leaf, which destroys the enzymes of fermentation and results, on infusion of the leaf, in the production of an almost colourless but pale yellow liquor.

The colour and characters of tea infusions, in general, are influenced by the tannins in the leaf; (6) these belong to the Catechol-tannin group. During the fermentation process in the manufacture of tea, the enzymes interact on these tannins, forming substances of varying solubility and colour ranging from pale-yellow to light-red and brown, which account for the colour and some of the characteristics of tea liquors. In the manufacture of black teas it is stated by tea chemists (4) that much of the caffeine combines with the tannin to form caffeine tannate which inactivates the caffeine, whereas the processes employed in the manufacture of green and China teas leave the caffeine mostly unchanged, and this accounts for the greater stimulating effects, particularly of high-grade China teas, as compared with black teas.

Manufacture of China Tea at the Central Experiment Station, Serdang.

Trials in the manufacture of China tea were undertaken during 1940-1941. The figures mentioned in this article, in relation to manufacturing costs, market prices and sales, are based on the prevailing wages and market conditions at that time. In the manufacture of China tea, leaves from Assam, Manipuri and China jats were used, the objects being as follows:—

(a) To obtain information on the Chinese hand process under local conditions.

(b) To experiment on the possibility of producing fair quality, China tea by partial use of black tea machinery with the ultimate object of encouraging local production.

Manufacture by the Chinese Hand Process.

Building.

A portion of a building, 12 ft. x 28 ft. x 8 ft. to the eaves, was adapted for use as a factory. The factory was enclosed on two sides by weather boards; the third side was open and the fourth side was constructed of brick and concrete, along which two fire places were constructed. These were surmounted by two shallow cast iron pans, (" kwalis ")* set to lean forward at an angle of about 30° from the horizontal, with the top rim facing forward to the inside of the building. The fire-hole doors were arranged outside the building so that smoke could not enter the building, but was conducted along flues to a central chimney. This method of construction and stoking of fires does not interfere with the workers while they are attending to the treatment of leaf in the pans, and they are also relieved of the necessity of standing near to open fires.

These " kwalis " are suitable for manufacture of hand-made tea and could be installed in factories where the ordinary black tea machinery may be partly used in the manufacture of China teas.

In addition to the " kwalis ", four cylindrical fireplaces called " poeylongs " are sunk into the floor; each is 2 ft. in diameter and 1½ ft. deep constructed of bricks and mortar and utilizes charcoal fires for the intermediate and final firing of the tea. Good quality charcoal is necessary to obviate the production of smoke within the factory, and to prevent smoking of the tea.

Additional appliances which are necessary are as follows:—

(1) Four, specially designed, cylindrical, closely woven, bamboo baskets 2 ft. 6 ins. in diameter and 2 ft. 6 ins. long, having open ends and a " waisted " construction with an inside, central rib on which can be placed a circular, fine-meshed, bamboo sieve to hold the leaf whilst it is being "fired" over the " poeylongs." The weave of these baskets is important and a close,

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* " Kwalis " are wide, shallow, cast-iron boiling pans.

simple, diagonal weave is preferable to one in which the strands are interwoven with a skeleton of ribs at right angles. The latter form of weaving provides interspaces through which the heat is lost.

(2) Four additional trays to cover the upper opening of the bamboo baskets to retain the heat while the firing is in progress.

(3) One bamboo, circular tray, 4 ft. in diameter, which is suspended from a beam by three ropes and is used for aerating the leaf.

(4) One rectangular mat 2½ ft. x 5 ft. constructed of woven bamboo, having the ordinary woven, uneven surface, on which the leaf is hand-rolled; this type of surface facilitates the twisting of the leaf.

(5) One wooden tray, 4 ft. x 4 ft. on which a secondary rolling of the leaf takes place.

In a factory of the dimensions quoted, and employing the above appliances, an output of about 70 lbs. of hand-made tea can be turned out per day.

Plucking.

In the manufacture of China teas, the unopened, rolled leaf at the end of the young growth, does not, after processing as in the case of black tea, produce a " tip " which has a high sales value. The process results, instead, in the development of a greenish colour in the manufactured leaf which impairs the appearance of the finished product.

Tea dust and small particles have, also, little commercial value in China tea. It will be appreciated, therefore, that the production of these grades must be avoided as far as possible and that their elimination should commence from plucking.

The optimum time for the development of two or three leaves, ready for plucking, in the Assam, Manipuri and China jats at Serdang is approximately 7 days for 2 leaves and 12-14 days for 3 leaves. Coarse plucking results in the development of a bitter and very astringent liquor which should not be confused with the normal taste or flavour of tea. Stalks are excluded as far as possible from the plucked leaf. " Bangi "† leaf if young and tender may be included, but if mature and tough, having been over-looked for one or more pluckings, should be plucked and discarded.

On no account must leaf be allowed to lie about in large heaps or in baskets, particularly if it is compressed, or fermentation will commence to the detriment of the quality of the finished tea. The plucked leaf requires to be transported to the factory as frequently as is practicable; in any case it should not lie about longer than three or four hours.

Records at this Station show that the yield of leaves, under a system of fine plucking (two leaves and a bud) for manufacture of black tea, has averaged 3,601 lbs. green leaf, equal to 846 lbs. of made tea per acre. Some experimental plots have yielded more than double this figure. The estimated yield of made tea per acre, grown by Chinese squatters in Selangor, is about

† " Bangi " is a mature leaf at the end of shoots which have stopped growing.

466 lbs. The yield per acre in China is reported to vary between 400 and 500 lbs. The small areas of the China jat at the Central Experiment Station, Serdang, which show little variation in type, were established by the planting of seed purchased from squatters in the neighbouring district of Sungei Besi.

The ordinary method of the establishment of seedlings in nursery beds was adopted, with subsequent transplantation of seedlings or stumps into the field.

There appears to be no reason why greatly enhanced yields, over those obtained by Chinese squatters both in Malaya and China, could not be obtained by modern methods, which would of necessity include soil conservation and liberal manuring.

Hand Manufacture of China Tea in China.

Variations occur in the hand processing of tea in different districts of China, but, in general, the manufacturing methods adopted are as follows:—

The leaf is withered under shade, usually on the floor of the factory, for a period of 4 to 6 hours; the rate of spread being 1 lb. of leaf to 2 sq. ft. of floor space. It is undisturbed for the first 2 to 3 hours, after which, at intervals of 20-30 minutes, it is placed on the suspended bamboo tray and agitated by a jerking movement of the tray for about five minutes, after which it is again spread for further withering. During the second 2 to 3 hours the aeration of the leaf is alternated with withering, during which time the leaf assumes a light-brown colour, which is more pronounced along the edges. A chemical change, which includes slight fermentation, takes place causing a distinct aroma to develop in the leaf.

When the light-brown colour has spread over about one third of the surface of each leaf, the batch is ready for the first heating to destroy the enzyme of fermentation. This is carried out in the " kwalis " which have previously been heated to a temperature of 280°F. to 300°F. The leaf is then loaded into the pans and this temperature is maintained. In order to prevent scorching, the leaf is constantly turned by the use of a wooden paddle for a period of about 10 minutes. After the leaf has become flaccid, it is taken out and hand-rolled on the rough-surfaced, bamboo mat for about 10 minutes. It is then rolled a second time, usually on a smooth surface of boards. A certain amount of juice, which is discarded, is extracted by pressure of the hand during the rolling. The leaf is then aerated by spreading on the board and is then allowed to cool for about 15 minutes. After cooling, it is put on the small trays inside the baskets over the " poeylongs " and dried for periods of 5 minutes at a temperature of about 105°F. which is recorded on the surface of the drying tea. After each heating period it is removed, turned and mixed to obtain an even drying. This process is repeated about three or more times until the leaf is half dried. It is then placed in a dry, cotton bag and compressed by

twisting the ends of the bag in opposite directions to fix, to some extent, the twist on the leaf and coalesce the fine particles of tea dust to form " gun powder " tea. This twisting also removes excess moisture and carries away some tannin. After this treatment, the balls of rolled leaf are laid in small heaps on the tray over the " poeylong " for further drying.

When the tea is almost dry it is removed, and the finer portions, in the form of " gun powder ", corresponding to " fannings " and " dust " in black tea, are removed from the bulk by the use of bamboo sieves. The two portions are fired separately at the same low temperature over damped-down " poeylong " fires. Drying in this manner is continued until the leaf is crisp and brittle. The process is more one of drying than of firing, in order to conserve the essential oils in the tea which impart flavour and aroma.

The drying in the " poeylong " is considered to be of vital importance, and the fires are always damped down to emit a regular flow of heat at a fairly low temperature. The fire is started at the bottom of the " poeylong " by igniting fairly large pieces of charcoal by the use, preferably, of a few glowing embers of charcoal, and the " poeylong " is then completely filled with charcoal. As the fire grows in intensity, and when the whole of the charcoal is aglow, it is rammed by the edge of an iron tool, such as a spade or a " penkali,"‡ which consolidates and reduces the fire to about half the original depth. The " poeylong " is then filled with paddy husk which burns and gives an even glow of heat for a period of 3 to 4 days.

The flavouring of China tea, by the use of fragant flowers as previously mentioned, is carried out before the tea is completely fired. The final firing process is interrupted by the removal of leaf from the drying tray, at which time the flowers are added in the proportion of about 1 to 3 per cent. of the half-made tea. The flowers may be used two or three times. The mixture is sometimes stored overnight in an earthernware jar and fired the following morning. After firing, the flowers are picked out of the made tea. Samples drawn from stocks, made by this method at Serdang, were valued by Chinese tea merchants in Kuala Lumpur at 40 to 48 cents per kati, wholesale, which would permit a retail price of 60 to 65 cents per kati.§

The results of trials at Serdang showed that, without the addition of flowers, a medium-grade China tea could be made by hand methods, but that high-grade teas could not be produced. Serdang is not favoured with the necessary sub-tropical climate, or the requisite altitude, to provide climatic conditions suitable for the production of high-grade teas.

Whilst such teas can be made by Chinese squatters and their families where labour charges are not so important, it is out of the question to apply hand methods to an estate output. Accordingly experiments were initiated at the Central Experiment Station, Serdang, to evolve a method by which

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‡ Penkali—An Indian tool used for digging post holes.
§ Kati = 1⅓ lbs.

black tea machinery could be utilized to eliminate the excessive labour charges involved in the production of hand-made teas, and still produce a tea, possessing the required characteristics of medium-grade tea, acceptable to the labouring and peasant classes of Chinese.

Machine-made Green Tea Produced at Serdang.

The machinery used at Serdang for the manufacture of this tea is described below:—

1. Boiler for generating steam.

2. Hexagonal drum made of 1/16 in. galvanized iron plate, 5 ft. 9 in. long and 2 ft. 6 in. wide, with a perforated steam pipe running through the central bearings and extending to the full length of the drum, with a steam intake at each end. This drum revolves at a speed of 15 revolutions per minute and is fitted with a tight door the full length and breadth of one face of the hexagon. A drum of this size, when three-quarters full, will process about 150 lbs. of green leaf per charge.

3. Tables constructed of reinforced concrete set onto an angle-iron frame, having three tiers, for cooling and draining the steamed leaf.

4. One " Little Giant " tea roller.

5. " Venetian tea dryer ", for drying the leaf by hot air.

The dryer, operating at a temperature of 225°F. will dry about 70 lbs. of wet leaf per hour. In practice the drying rate varies with the moisture content of the leaf loaded into the machine.

6. A cylindrical drum, 3 ft. long and 1 ft. 7in. in diameter, having three baffle plates fitted inside from end to end, at an angle of 45° with the perimeter of the drum. The drum is revolved on a central shaft supported by bearings at each end; beneath the drum a charcoal fire is carried on a low tray fitted with two small wheels at each end in order that the fire can be placed under the drum or withdrawn as required.

Manufacture.

The fresh leaf, namely a bud and two leaves as plucked from Indian jats for the manufacture of black tea, is heaped in the factory in lots of 150 lbs. to undergo a slight fermentation for a period of about one hour.

The partially fermented leaves are then placed in the hexagonal metal drum, which has been previously warmed by injecting steam into it for about 1 minute before loading with leaf.

When the drum is loaded with leaf, steam is admitted at about 50 lbs. pressure, and the drum is then revolved for 2½ minutes at a speed of about 15 revolutions per minute. If the steam is admitted at a lower pressure the process takes a longer time. The leaf after being subjected to the right degree of steaming is firm and pliable, and emits a fresh smell. It breaks with gradual pressure but does not snap; the colour is a dull, even green. If the leaf is under-steamed it is bright-green, uneven in colour, and breaks during rolling; the liquor of such teas after completion of the process lacks character. The leaf when over-steamed is dull-brown in colour and smells sour, the stalks are soft and become squashy on rolling.

The following average weights and temperatures were recorded after steaming.

Weight of fresh leaf per charge	Weight of leaf after steaming and draining	Temperature of steamed leaf
150 lbs.	145 lbs.	167°F.

The steamed leaf is immediately removed to the concrete surfaced table on which it is spread to cool and to permit superfluous moisture, from condensed steam, to drain away. It is spread at the rate of about 1¼ lbs. per sq. ft.; thin spreading is necessary to permit dissipation of heat. About 20 minutes are required to cool the leaf sufficiently to permit rolling to commence. Weights recorded at Serdang were as follows:—

Average weight of steamed leaf after spreading on the table and draining	Average weight of leaf after draining and cooling on the table before charging the roller
145 lbs.	135 lbs.

The steamed leaf, when sufficiently cooled, is loaded in quantities of 65 to 70 lbs. into the tea roller. Additional moisture adhering to the leaf is removed by allowing the weight in the roller to rest on the leaf for a period of 3 to 5 minutes before setting the machine in motion. The leaf is rolled for 45 minutes, the roller moving at a speed of about 60 revolutions per minute. For the first 10 minutes pressure is applied; this is followed by 10 minutes without pressure. These times and pressures are alternated during the 45 minutes rolling, the last rolling with pressure being only of 5 minutes duration.

In the process of rolling, a large proportion of the moisture left in the leaf after steaming is expelled by screwing down the weight on to the leaf during the rolling. The following table gives the weights of leaf at this stage.

Average weight of steamed leaf per charge	Average weight and temperature of leaf after rolling	
67½ lbs.	42 lbs.	86°F.

The rolled leaf is passed to the dryer and fired at a temperature of 212°F. until it becomes crisp. The time taken to treat two charges of rolled leaf is about 90 minutes and produces 26 lbs. of dried tea. The temperature of the tea when discharged from the dryer is about 140°F.

The fired leaf from the dryer is allowed to cool overnight and is then loaded at the rate of 45 lbs. per charge into the cylindrical metal drum. The drum is revolved at a speed of about 15 revolutions per minute for two hours and fifty minutes over a slow charcoal fire. The fired tea in the drum is maintained at a temperature of about 195°F.

During this process the tea is examined at intervals of about half an hour, and, after it has reached the required stage of flavour, dryness and polish, the fire tray is withdrawn and the drum containing the tea is revolved

until the temperature falls sufficiently to permit handling of the tea. The drum is unloaded and the tea is sieved to remove dust. Twenty-six lbs. of fired tea give twenty-four lbs. of finished tea.

About 10 lbs. of charcoal are required to heat the drum during the polishing and flavouring process for each charge of 26 lbs. The weight of made tea is about 18 per cent. of the green leaf.

The estimated cost of labour and manufacture (1940-41) was as follows:—

	Cents per lb. of made tea.
Plucking (fine)	8.00
Labour and supervision ..	3.50
Power and light	1.00
Firewood	1.25
Packing	.50
Charcoal	.75
	15.00

The Manufacture of Cheap China Tea.

The following results were obtained in trials undertaken to produce cheap teas to meet the needs of the labouring class of Chinese.

The machines used were two " Little Giant " tea rollers, one 42 in. " Venetian " tea dryer and two cast iron " kwalis " each 42 in. in diameter.

Process "A ".This process was adopted to produce a tea for general consumption. " Flush ", consisting of a bud and three leaves is plucked, and, on arrival at the factory, is spread on a cement floor (or on to tats*) to a depth of 4 to 6 ins. The leaves are allowed to wither and ferment for about 18 hours. During this period the leaf is turned and aerated once or twice. The object of this treatment is to cause even fermentation and withering.

Fermentation is then stopped by roasting the leaves in the cast-iron pans described previously. The withered leaf, in 50 lb. charges, is placed into the hot pan and stirred continuously by a wooden paddle to prevent burning. This process kills the enzymes and inhibits fermentation. The average period of firing withered leaf is 10 to 15 minutes.

The leaf now becomes flaccid and is rolled for 10 minutes. During this process a portion of the juice is extracted and the leaves acquire a twist.

The rolled leaf is then passed into the tea dryer and partially dried at a temperature of 230°F. The leaf at this stage is reduced to about 38 per cent. of the weight of fresh leaves.

* Tats are layers, usually of hessian, about 7 inches apart and 3 ft. 6 ins. wide constructed in tiers, on wood and wire frames in the withering lofts of tea factories, on which the freshly plucked leaves are spread to wither.

The leaf after treatment in the drier is placed in the hot pans and kept agitated for 1½ to 2 hours during which time it becomes crisp and begins to emit the characteristic odour associated with flavour. At this stage the leaf is sufficiently dried and is removed from the pan and stored in bins. The final drying of tea in pans requires great care in the regulation of the temperature; considerable experience must be gained to avoid scorching and to obtain satisfactory results.

The cost of manufacture of tea by this method was 2.31 cents per kati (or 1.73 cents per lb.) in 1940-41.

The tea was packed in sacks at the rate of 70 katties per sack, and 24.74 piculs of tea manufactured by the above method were sold during 1941 at $35/- per picul. (1 picul = 133⅓ lbs.), or 35 cents per kati.

Costs of producing black tea and China tea, and the market value of black tea (85% of the output) sold in London, and of black tea dust (15% of the output) sold locally, and of China tea sold locally, are compared below.

	China Tea cents per lb.	Black Tea cents per lb.
Field Charges ..	9.16	9.16
Plucking ..	3.10	6.20
Manufacture ..	1.73	7.45
Packing, transport and sales ..	0.10	7.40
Total Cost ..	14.09 cts.	30.21 cts.
Average value black tea (both grades) ..		41.68
Costs		30.21
Difference between costs and sales ..		11.47 cts.
China tea, sold ex-factory at 35 cts. per kati		26.25 cts. per lb.
Costs		14.09
Difference between costs and sales		12.16 cts.

It should be recorded that the power required in the manufacture of China tea is less than that necessary for black tea. Black tea costs were handicapped during 1941 owing to war conditions, a surcharge for steamer freight to London was levied and insurance rates amounted to 1.48 cents per lb.

From the above figures it will be seen that the field charges are assumed to be the same for both teas, but actual observations show that the plucking of China tea does not require the same amount of field supervision as for black tea, and therefore the cost of production can probably be further reduced. Moreover it may be seen from the table of

costs that the pluckers will bring in double the quantity of coarse leaf, for manufacture into China tea, as compared with the fine plucking required for black tea.

Process "B". This process was specially investigated to produce a tea to meet the demand by the Keh community, who prefer a tea with a greenish-grey colour, obtainable by stirring in a hot pan.

The withered leaves, after heating in the "kwali", are partially dried in the power dryer to remove a portion of the moisture in the leaf; afterwards it is rolled lightly in the tea roller. The rolled leaves are further dried in the tea dryer and finally dried in the pan. The cost of manufacture is about 4 cents per kati. The tea was valued (1941) at $35 per picul and 1½ piculs were manufactured and sold at the above price.

The results of experiments indicate that the manufacture of China tea by methods A and B can be undertaken with profit. The manufacture of tea by process "A" appears to meet the demand of many Chinese and therefore can be recommended for adoption on large estates.

In addition to the above, several other manufacturing processes were tried but are not recommended.

General Comments.

Tea made at Serdang has been tasted by local Chinese merchants and other interested persons, who considered it a satisfactory low grade tea. It commanded a ready wholesale price of about 30 cents per kati during 1941. It is considered that the quality can be much improved with experience in the manufacture, and it is not unreasonable to expect 50 cents* per kati, when the market is more fully exploited and the details of manufacture are better understood by the labourers, resulting in a more homogeneous product.

A tea artificially flavoured with jasmine, or other suitable flowers, is in local demand and commands a premium of about 6 to 10 cents per kati. If the cost of growing the flavouring flowers is considered to be too high, bottled perfumes, of which jasmine is one of the cheapest, may be used. These were being sold in Malaya during 1941 and were being used as substitutes for the fresh flowers. The spraying of partly processed tea by these perfumes reduces the labour costs of manufacture in comparison with the method of admixture of fresh flowers and the picking out of withered flowers from the finished tea.

Summary.

The investigations recorded above show that, in Malaya, the production of medium and low-grade China teas is possible by hand manufacture, or by the partial use of machinery normally employed in the manufacture of black tea. Furthermore, such grades of China teas can be placed on the local market to sell at competitive prices with similar grades of imported teas.

* (1941).

The altitude at Serdang, 160 to 250 ft. above sea level, with the normal wet tropical climate, 95 to 105 inches of rain per annum, encourages a steady growth of tea all the year round but is not conducive to the production of high-grade teas. The experiments have shown, however, that high yields of medium-grade China teas from Assam and Manipuri jats can be obtained and processed.

Such teas are acceptable by Chinese as possessing the characteristics of similar grades of imported China teas.

The experience gained at Serdang, in the manufacture of China tea, indicates that little difference in quality or type of made tea is obtained when Manipuri, Assam or China jat is used. The frequency of plucking has a marked influence on quality and fine plucking, i.e. down to one fully grown leaf and the newly opened leaf at the growing point, produces the highest grade teas.

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ANIMAL HUSBANDRY IN MALAYA

I. Cattle in Malaya (*Continued*)

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In Malaya there is an unusually wide diversity of objectives and methods in cattle keeping and this diversity is, in part, due to the fact that there are a number of different races of cattle owners involved, each tending to practise its own particular methods, and in part to the fact that different racial preferences and customs exist in different parts of the country. In the following sections the subject of cattle in Malaya is presented under the following sub-headings:—

(A) Cattle of Indian (Zebu) origin,
(B) Indigenous cattle,
(C) Cattle of European origin,

since this arrangement is in order of numerical and hence of commercial importance.

Cattle imported into Malaya up to 1941 came chiefly from Bali and, to a very much less extent, from Siam and French Indo-China; imports were mostly for slaughter purposes, imports of dairy cattle or of breeding stock being almost negligible.

A. Cattle of Indian (Zebu) Origin.

Indian cattle constitute the majority in Malaya as a whole, and are particularly predominant on the western side of the Peninsula south of Kedah. They are owned chiefly by Indian dairymen, and to a lesser extent by Tamil labour forces on estates, and are kept mainly for milk production, though there is also a considerable internal trade in surplus animals, particularly males, for draught purposes and for meat. A few estate companies also maintain their own herds.

In can be stated that although cattle in India have been developed from the same foundation stock, they have segregated into types probably influenced by environmental factors, but no doubt assisted, to some extent, by selection along certain lines.

Indian cattle in Malaya are fairly uniform in build and colour characteristics, there is however, in some herds, some variation in type, for instance a predominance of Ongole blood is manifested usually by the light-grey colour of their coats, but in many herds the fawn and dun

coloured cattle of Northern India predominate. The evolution of the Indian ox in Malaya would appear to be proceeding towards a medium to small-sized homogeneous animal, suited to the plane of nutrition available, which mainly consists of luscious fodder-grass of low nutritive value. Indian cattle keepers are very parsimonious in their feeding methods and only cattle in milk are, in general, supplied with a meagre addition of concentrates.

In the past, Indian immigrants imported large numbers of stock and it is from these importations that existing herds are descended. Some local owners claim that their cattle were imported from Southern India and others from the Punjab and the North, but it has not been possible to demonstrate any correlation between recognizable differences in build and type and district of origin as stated by the owners. This point has more than academic importance because there are two general types of cattle in India: and within these types, there are, as in Europe, what might be classed as distinct breeds:—

(a) The Northern breeds, which have in the main been selected and bred for draught purposes and milk production. The Northern breeds are inferior to the Southern for draught purposes, being slower and less active, but the yield of milk is double or treble that of the specialized working breeds of Southern India.

(b) The Southern breeds, which are, in general, draught animals and poor milkers.

Northern Indian Breeds.

The *Montgomery*, also known as the Sahiwal or Teli breed, is one of the best milking breeds. The horns are short, ears rather large and pendulous, hump fair sized, the skin and the coat are thin; the dewlap is large, and the sheath in the male and the fold of skin under the female well developed. The body frame is long, deep and massive, and is supported on short well-set legs. The colour may be black, grey, whitish, spotted or brownish-red. The cows have fairly well-developed udders and teats, and they yield up to about 3 gallons of milk per day when in full milk.

These cattle are reputed to lose some of their fine milking qualities when taken from their natural habitat (which is comparatively dry) to the more humid parts of the tropics; also they are said to breed more slowly. Despite this, the Montgomery has been used to a considerable extent for cross-breeding in India and to a limited extent in Malaya.

The *Scindi* breed is reputed to carry some of the best milking strains in India. These cattle resemble the Sahiwal but have a smaller and more compact body. The bulls have a slow gait and cannot be classed as good draught animals; they should interbreed with local oxen without unduly influencing the size of the progeny. In this respect it is considered that small-framed oxen, in general, thrive better, on the typical Malayan fodders of low nutritious value, than animals of the larger breeds, and, for this

reason, bulls of this breed should be useful for upgrading of milk production in Malaya.

The *Hansi, Hissan or Hariana* breed is found in the Punjab and neighbouring districts, and is, in many respects, like the Montgomery and Scindi breeds. The Hansi is considered by many to be one of the best all-round breeds in India. It is a general or dual-purpose breed, giving a fair yield of milk. The bulls are considered to be good draught animals, although somewhat slower walkers than the pure draught breeds, and are excellent in the plough or for drawing heavy loads.

These cattle are large, well developed, of various colours but mostly grey or whitish. They have large dewlaps but the males have only a small sheath. They are reputed to cross well with the Friesian.

Southern Indian Breeds.

The *Nellore or Ongole* breed comes from the Madras Presidency and is noted for its size and draught qualities being particularly suited for slow heavy haulage. They are not, therefore, particularly good for road work, and even the best cows of this breed very seldom yield 1½ gallons of milk per day.

The *Mysore* breeds are tall, active, muscular draught animals. They are exceptionally good for road work, and are the mainstay of South Indian agriculture as draught and ploughing bulls. Large numbers of this breed have been imported into Malaya in the past.

Despite the uncertainty as to origin referred to earlier, it is felt that the local Indian cattle are inferior to their parent stock in good districts in India, while the remarkable uniformity of build and type encountered in the majority suggests that the typical Indian cattle, now in this country, are, possibly, a genetically homogeneous mixture of the different breeds imported originally. The head is long and narrow, horns generally short and curved upwards and outwards, hair short and close, and the skin is pigmented. The body is light and narrow, with a tendency to height in front and lightness of the quarters—it is " slab-sided." The hump is most conspicuous in the males, being present to a variable degree in females. The " top-line " falls away steeply from above the point of the hip to a low-set tail head. The dewlap is fairly voluminous and the legs long.*

Indian cattle in this country are used chiefly for milk-production, though considerable numbers, particularly of surplus males, are used for draught purposes and for meat. The typical Indian milch cow in Malaya is ill equipped for the purpose of commercial milk production. The causes of this are mainly bad breeding methods and inadequate feeding.

Throughout Malaya the most elementary principles of animal breeding are ignored. Attempts to select superior sires are rare while uncontrolled breeding, with consequent inbreeding, is rife. As a consequence, the

* " Indian Farming," Vol. I, Nos. 2 and 3, contain comprehensive descriptions of many Indian breeds of cattle and bufflaloes.

average calf is of poor quality at birth, whether considered from the standpoint of physique or of its genetical inheritance.

Calves are almost invariably milk-starved from birth, since it is an economic necessity at present for the dairyman to sell as much milk as possible. This early sub-nutrition continues during the growing and adult stages, due to inadequate pasturage and insufficient supplementary concentrates, thus depressing the economic potentialities both of good and of bad stock alike. It is uncommon to differentiate between good and bad when apportioning the available fodder and concentrates, the use of communal feeding troughs being general. The combined result of the two factors mentioned above is to produce small to medium-sized, slow maturing animals, with a considerable proportion of weak and unthrifty individuals, and improvement in both breeding and feeding will be required in order to raise the standard of local Indian cattle.

The provision of adequate pasturage, or of fodder areas to permit stall-feeding, probably belongs to the sphere of official intervention, while only research will indicate the nature and quality of concentrate mixtures required to maintain good, average stock in a reasonable condition. To this extent, therefore, improvement lies outside the scope of the dairyman, and, in this connexion, it is of fundamental importance to remember the *economic* axiom that any extra expense and labour, incurred by superior feeding, must show at least an equal return in extra income, and preferably a handsome profit. Turning now to breeding we enter a sphere in which the local cattleman is in a position to start helping himself. Simple measures, such as early castration of scrub males (males unsuitable for breeding), and the early disposal of these, and of the more obviously degenerate females for meat, would be of considerable value and would entail but little expenditure either of labour or of money. Such methods, which represent elementary, selective breeding within the existing milch herds, possibly in conjunction with the importation of good quality bulls from India, probably represent all that can be accomplished in the next decade or so. If the measures mentioned above are not adopted feeding alone will be negatived and it is difficult to see how, otherwise, the past and present trend, which is one of gradual deterioration in quality, can be reversed.

B. Indigenous Cattle.

Malay cultivators in the rural parts of Kedah, North Perak, Kelantan and Trengganu keep considerable numbers of cattle, and these are almost entirely what might be termed moderate-sized, general purpose, draught-cum-beef stock of the Siam-Kedah breed.

These animals are of considerable interest, since they appear to be descendants of original stock which probably spread southwards from Siam. They do not appear to be inter-bred with stock from any other outside source and could probably be described as an indigenous breed, conditioned over a long period by the factors of local environment and local

methods of husbandry. They exhibit a certain measure of conformation to a type and the following characteristic features are, in general, representative.

(a) Head is broad and short, tending to flatness in the frontal region. Eyes prominent, ears small and pointed, tending to droop; horns small or average, of varying shapes; neck tends to be short, narrow and deep.

(b) Body is long, with well sprung ribs, full flanks, fairly broad back with a straight top-line from behind the hump to the tail head. Hump is usually well developed, particularly in entire males. Tail long and fine, with a switch almost reaching the ground. Udder in cows is small.

(c) Legs are short and finely boned, while predominant colours are red and red-duns†, though duns and blacks are not uncommon.

Compared with the typical Indian cattle on the western side of the Peninsula, the Siam-Kedah breed differs in the shape of the head (short and broad versus long and narrow); shape of body (broad, well sprung versus narrow and slab-sided); top-line (straight versus a rump which falls away from pelvis to low-set tail head); legs (short versus long) and size (moderate versus somewhat larger). The Siam-Kedah breed as a rule, appears to carry better condition than the Zebu and the animals convey the general impression of being compact, stocky, and hardy.

The Northern States of Kedah, Kelantan and Trengganu differ from the remainder of the States in the Peninsula in that they contain large tracts of flat country, much of which is cultivated, and relatively considerable numbers of livestock. The somewhat special position of cattle in Kelantan and Trengganu merits individual mention, but it is of interest to note in passing that Kedah is completely self-supporting in respect of beef requirements.

Kelantan.—There are large areas of cultivated land, on which both wet and dry padi and other crops are grown. The average size of holding is small and holdings are, therefore, numerous; ploughing is the general rule, and, as cattle are preferred to buffaloes for ploughing in all but the relatively small areas of low-lying swamp land, large numbers of cattle consequently are kept by the cultivators in this State. The small, sturdy Kelantan type, of the Siam-Kedah " breed ", is well adapted for the chief type of ploughing required; they are also excellent foragers and, given adequate feeding, produce a good carcase of beef.

Export of cattle from Kelantan is prohibited and slaughter for home consumption is controlled by a system of permits so that the Kelantan plain, in normal times, is markedly overstocked so far as ploughing requirements are concerned, with the result that there is likely to be a pronounced shortage of pasturage and fodder generally during the padi-growing season. During the off-season the cattle are grazed on the padi stubble, supplemented by

† dun = a dull greyish-brown colour.

cut grass and other grazing, and normally attain fair condition. During the padi season, however, herd movements to, in some cases, distant grazing areas are not uncommon. If this is not possible, the cattle are tethered and many owners walk considerable distances to find and cut fodder for their stock. When it is stated that half a hundredweight of grass is considered the usual daily ration for an adult animal the reader will realize how much work is involved by this procedure, particularly as special fodders for cutting are not grown to any appreciable extent.

Trengganu.—In the Besut area, conditions are similar to those of the Kelantan plain described above, except that the smaller density of raiat population, and consequently of cattle, provides for far more available forage. In other parts of this State, buffaloes play a greater part in padi cultivation than do cattle, with the general result that Trengganu is in a strong position for exporting surplus cattle.

The Malay, as a rule, keeps his cattle for draught and meat alone. It is very unusual for him to milk cows or to consume liquid milk, hence the calves usually receive a better start in life than do Indian calves. It must be remembered, however, that as a result of education and propaganda Malays are being taught to appreciate the value of milk in the human diet and this fact may, in future, result in a tendency to milk-starve the calves. The average raiat usually finds that the male is more suitable than the female for his particular purposes, and, in some parts of the country, he thus tends to get rid of his female stock, so that there is subsequently a shortage of dams.

The outstanding problem again is the provision of sufficient fodder or grazing, particularly during the padi season. The severity of this problem varies. It is particularly acute in Kedah, for example, but not much less so in Kelantan. It is suggested for future consideration that one solution of the problem would be to introduce rotation into padi cultivation, i.e. to set aside and use as grazing ground each year say one third of the sawah area, rotating the grazing and padi areas as in other systems of agriculture. However this may be, and only the future will elucidate the best methods, there would appear to be quite distinct economic possibilities for beef cattle production in the northern and eastern padi-growing areas of the Peninsula, designed largely to supply urban market requirements throughout the country. Animals of the Siam-Kedah breed appear to be quite well adapted to their environment, and would perhaps require less attention to the breeding aspects of improvement than, say, the Indian milch cow.

C. Cattle of European Origin.

Europe, particularly Western Europe, is the home of many breeds of cattle which, by virtue of their merit, have spread everywhere that is climatically suitable for them. One need only mention famous breeds such as the Ayreshire, Jersey, Guernsey, Friesian and Shorthorn to realize that this is so. Of these, only the Friesian, Guernsey and Jersey need be

mentioned in the case of Malaya, as these are probably the most likely European breeds to stand a chance of assuming any importance under local conditions. It should be understood, also, that under the heading of this section are included animals imported not only from Europe, but also from North America, South Africa and other countries where the European breeds have become established.

The *Friesian* Breed. This originated in Holland some centuries ago and is now numerically the strongest dairy breed in Britain, Holland, the United States of America, Canada, Australia, New Zealand and South Africa, and has established itself in a number of tropical countries for upgrading purposes in conjunction with *Bos Indicus* the Indian Ox.

The cattle are large, well fleshed and of true milking type, being coloured almost invariably black and white. The head is fairly long and should possess a wide muzzle and nostril. The neck is of normal dimensions. The chest is deep and thick, the back is wide, with well-sprung ribs and wide, flat loins. Hindquarters are wide, thick and long, and heavier than in most milking breeds. These animals, provided that adequate rations are available, are, in general, bigger than most dairy breeds; they carry more meat and fatten easily, while the calves are said to make good veal.

The breed is noted for its high yield of milk, many of the best cows producing in excess of 20,000 lbs. (say 2,000 gallons) of milk a year. The fat content, normally is lower than most of the other dairy breeds, as shown by the following averages:—

Jersey—5.4%. Ayreshire—4.0%. Friesian—3.4%.

In some countries the fat content is too low by itself to pass the legislative minimum standards of milk for consumption. In such cases, farmers frequently keep a few Jersey or Guernsey cattle so that by mixing the two milks the fat content of the mixture may be raised to the required standard. Friesian milk is particularly good for cheese manufacture.

The *Jersey* Breed.—This is possibly of French origin and is considered by many to be the oldest and purest milk breed. It has been isolated and bred for some centuries in the island of Jersey, which lies in the Channel separating England and France. Importation of cattle into Jersey has been prohibited for the last 170 years or so, hence the breed has been maintained very pure and free from diseases such as tuberculosis.

This breed is a milking type, the cows being wedge-shaped small, finely boned and fine skinned. Prevalent colours are fawns, browns and greys, while the presence of a light-grey ring around the muzzle distinguishes the Jersey from other Channel Island breeds such as the Guernsey. It carries very little flesh and is of very little value for meat purposes.

Yields are moderate, but the milk is very rich in fat and protein, and is very suitable for butter-making.

The *Guernsey* Breed.—It is thought that this breed, which has been gaining popularity during the past decade, possesses characteristics which would make it well worth a trial on the tropical highlands.

The Guernsey is generally considered to be more hardy while possessing the good qualities of the Jersey breed contained in a better-fleshed body, such as a fine skin, light thin coat and a medium sized body, which is preferable to the large breeds in so much as small animals thrive better on meagre supplies of fodder of low nutrition value. Cows of this breed give high yields of milk with a fairly high fat content.

The Friesian and Jersey are the most important of the European breeds in Malaya, though before the war there were very few even of these. Such animals are normally kept in certain commercial farms, usually situated near large towns or at upland places such as Maxwell and Frasers' Hill-Stations and Cameron Highlands. They are usually under expert European supervision and, in general, lead a very artificial existence. At one lowland establishment for instance, artificial ventilation and air-conditioning was provided before the war. Such methods can never form part of general animal husbandry in Malaya; they are economic only because there is a definite, though limited market for fresh milk in which price is relatively unimportant provided the quality is high.

It is contended by many authorities‡ that European breeds of cattle suffer from serious disabilities when maintained on the lowlands of the wet tropics. The heat controlling mechanism of European cattle is not adapted to high temperature with an atmosphere almost saturated with moisture particularly if this is associated with little seasonal variation in the climate. Most European breeds when stationed in the tropics also develop their characteristic temperate climate, winter coat, which increases the difficulties of the heat regulating mechanism of the animals. The unsuitability of tropical living conditions is manifested by a higher body temperature with increased pulse and respiration rates, with the consequent loss of efficiency of the animals. Furthermore, air movement in the tropics is normally at a slow rate which aggravates the prevailing conditions and makes it even more difficult for the animals to throw off surplus body heat.

Attempts before the war to breed and rear European cattle at Serdang and Singapore using a high plane of nutrition, resulted in undersized animals at maturity, with a high rate of infertility in female stock.

It is suggested that European cattle can remain healthy and vigorous in the wet tropics at an altitude which provides a mean temperature not higher than 65 to 70°F.

Allowing a fall in temperature of 3½°F. for each 1,000 feet of altitude and taking the mean temperature on the plains at 80°F. it will be seen that an elevation of about 4,000 feet is required to provide suitable conditions for European breeds of cattle.

The possibility of using European breeds such as the above for upgrading purposes under local conditions will be referred to later when considering the general problem of improvement of stock.

(*To be continued*).

‡ Norman C. Wright. Report on the Development of Cattle Breeding and Milk Production in Ceylon 1946. Sessional Paper XX, 1946.

THE RUBBER RESEARCH INSTITUTE OF MALAYA SMALL-HOLDERS' ADVISORY SERVICE

BY

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Prior to 1934 the Rubber Research Institute had no means of direct approach to the owners of relatively small rubber areas. This was due to the small size of the holdings, their scattered distribution and the lack of suitably qualified officers to work in small-holding areas. With the development of the School (now the " College ") of Agriculture at Serdang suitably trained staff became available and a special advisory service to small holders was formed for the benefit of those whose principal interests were in rubber cultivation.

In 1934 the R.R.I. Small-Holders' Advisory Service (S.H.A.S.) was inaugurated with the appointment of 9 Asiatic Rubber Instructors. These men and all later appointees have passed the diploma course of the College of Agriculture, Serdang, and have received a further special course of training at the Rubber Research Institute in the practical aspects of rubber cultivation, collection and manufacture in accordance with good and well tried methods. Rubber Instructors are attached to the Agricultural Offices in the districts to which they are posted. They work under the day-to-day supervision of the Agricultural Officers in charge of the districts in which they are stationed. Guidance in advisory policy and provision of technical information likely to be applicable on small rubber holdings is given by the Rubber Research Institute. Malay Rubber Instructors now frequently have the assistance of Malay Rubber Demonstrators who are trained to repeat the simple lessons of tapping and sheet manufacture throughout the kampongs. These men also assist in budgrafting work, smoke-house construction, anti-erosion practices and treatment of the common pests and diseases.

The S.H.A.S. developed steadily up to the outbreak of war in the East, and by 1941 it consisted of 41 Instructors and 20 Demonstrators. The service was directed from headquarters by a full-time Small-Holders' Advisory Officer with the part time assistance of the Personal Assistant to the Director who had previously been a specialist advisory officer. By that date the production of slab rubber had been practically eliminated throughout the country and small-holders were producing fair quality sheet, sold either wet, air dried or smoked. Efforts were directed to the continued improvement in quality of the manufactured sheet and to ensure that the small-holder obtained a fair reward for the improved product. For those who

could be persuaded to obtain the extra profit from smoking, a special smoke cabinet had been developed suitable for use on the smallest holding. Full attention was always given to improvement in tapping methods and to limitation of bark consumption, and while these efforts, at the time, may have appeared to meet with only limited success, their fruits are becoming apparent now in the greater attention paid by small-holders to the tapping of areas planted during the last few years before the war. These areas bear testimony to the value of the work done on the replanting and new planting of rubber, and to the fact that given the materials, advice and encouragement the small-holder is fully able to take advantage of all improvements in methods which are applicable to his own circumstances.

The Small-Holders' Advisory Service has suffered a severe loss in the deaths on active service and in a prisoner-of-war camp of the two senior officers responsible for its pre-war development. The service was not maintained during the Japanese regime and we commence the post-war period with a depleted Staff. Every effort however is being made to maintain and increase the scope of the service and to shape it to the needs of the small-holder.

It is hoped that advantage will be taken of the relaxation of the restrictions on new planting and replanting and that a considerable development of young rubber areas will take place on small-holdings. Only the best proved planting material will be provided for this purpose. In making recommendations to small-holders consideration is given to their particular requirements, to the smallness of the units concerned and to the limited capital available.

While many faults in manufacturing technique remain to be corrected on individual holdings, really spectacular improvement in the finished product can now best be achieved if larger manufacturing units can be arranged. The S.H.A.S. is anxious to see extension of the development of Co-operative Societies amongst rubber growers throughout the country and works in close collaboration with the Co-operative Department. The advantages of co-operation amongst small-holders for the manufacture of sheet rubber may be summarised as:—

Improved equipment.

Provision of good water supply at limited over-all cost.

Ease of control of a few skilled workers under the direction of a mandor, and better division of labour between them.

Economy of acid through overnight coagulation.

Increased profit from better sheet, and the possibility of grading and bulk sales which can eliminate the middleman.

A few co-operative manufacturing centres with smoke-houses are already in existence and provide convincing evidence of the greater profit obtainable by small-holders who are prepared to co-operate. By co-operation it may also be possible for small-holders to sell their latex to concerns who are interested in the export of liquid latex. Further developments in the

production and co-operative marketing of latex by small-holders will be carefully studied.

Rubber Instructors seek work only amongst owners of their own nationality but this need not prevent a Chinese or Indian, for example, approaching a Malay Instructor with any rubber growing problems. Subjects of particular difficulty will always be referred to the Rubber Research Institute by Rubber Instructors. Recommendations are based on practical considerations, and small-holders are assured of sympathetic consideration of their particular problems.

A list of Rubber Instructors is appended. The services of these officers can always be obtained free of charge on application to the appropriate Agricultural Office or direct to the Rubber Research Institute.

Malay Rubber Instructors.

	Names		Station
1.	Abdul Aziz b. Mohd. Jaafar	..	Kajang
2.	Abdul Rahman b. Haji Daud	..	Ipoh
3.	Abdul Rahman b. Panjang Aris	..	Telok Anson
4.	*Hussein b. Haji Alang Samsudin	..	Taiping
5.	Kassim b. Hassan	..	Kota Bharu (Kelantan)
6.	*Mohd. Aris b. Ahmad Fathil	..	Johore Bahru
7.	Mohd. Jamli b. H. M. A. Wasi	..	Batu Pahat
8.	Mohd. Johar b. Mohd. Rashid	..	Malacca (on leave)
9.	Mohd. Noordin b. Ahmad	..	Kuala Lipis
10.	Mohd. Piah b. Alang Mat Aras	..	Kuala Kangsar
11.	Mohd. Razalli b. Uda Yahya	..	Pekan
12.	Mohd. Rouse b. Haji Mohd. Amin	..	Sungei Patani
13.	Mohd. Shafii b. Haji Ludin	..	Rembau (on leave)
14.	Ramli b. Haji Abdul Rahman	..	Parit
15.	Samsuddin b. Mohd. Arabee	..	Klang (on leave)
16.	Shaharun b. Haji Abdul Rahman	..	Kuala Kubu Bharu
17.	Shamsudin b. Yub Ahmad	..	Kuala Trengganu
18.	Sa'ad b. Musa	..	Temerloh
19.	Wan Chik b. Abdullah	..	Kulim (on leave)
20.	Yahya b. Ma'amor	..	Muar
21.	Zainal Abidin b. Baharudin	..	Jitra
22.	Zakaria b. Haji Abdul Karim	..	Kuala Pilah

Chinese Rubber Instructors.

1.	Chan Seng Keat	..	Nibong Tebal
2.	Cheah Kwok Choy	..	Taiping
3.	Eu Eng Hoe	..	Kuala Lumpur
4.	Lee Choo Kooi	..	Ipoh
5.	Lee Yew Siong	..	Seremban
6.	Wong Cheng Boon	..	Muar
7.	Chai Hon Chee	..	Segamat
8.	Wong Mun Yun	..	Malacca
9.	Low Kai Choy	..	Batu Pahat

Indian Rubber Instructors.

1.	*Diaz, Gerard	..	R.R.I.
2.	Jebaratnam, M.	..	Taiping
3.	Muthucumaru, M.	..	Seremban (on leave)
4.	Samuel, John G.	..	Kuala Lumpur

* Superintendent Rubber Instructor.

Selected Articles.

STORED PRODUCTS PESTS* (ABSTRACTED)

Insect and related pests which feed on the wide range of commodities usually referred to as stored products are responsible for considerable losses in this State. Such commodities include grain and grain products, dried fruits and vegetables, nuts and nut meats, and products of animal origin such as ham and cheese as well as the numerous foods for both human and stock consumption which are prepared from one or more of these main classes of raw materials. The majority of the pests involved are either beetles or moths; the remainder make up a miscellaneous group which includes flies, psocids, and mites.

The beetles include several weevils but most of them are not true weevils, though they are commonly referred to as such. They are nearly all rather small, hard-bodied insects. Both the adults and larvae of these species feed in the infested material throughout their life and thus are usually found together. The adults of several species are very long-lived, some surviving for at least three years.

The adults of moth pests, on the other hand, do not feed on stored products and thus cause no direct injury in this stage of their life. Their mature larvae usually either leave the infested material before pupating or they pupate in such a position that the moths on emerging from the pupae may readily escape into the open. Thus the moths of these stored products pests are commonly found resting on the containers of the infested material, or on the walls of—or flying round—the building in which the goods are stored. In this stage, too, they live for only a week or two. The larvae of these moths characteristically spin silken threads wherever they go and also construct silken cocoons, this habit distinguishing them quite definitely from beetle larvae.

Pests in the miscellaneous group have no general characteristics in common. Psocids and mites are very small, the latter being scarcely visible to the naked eye. As in the case with beetles, all stages of psocids and mites are found together in the infested material. The adults of fly pests, on the other hand, are usually seen resting on or flying round the material in which their larvae are feeding.

Control of Stored Products Pests.

Merchants, farmers, and housewives may combat insect infestation of stored products by the adoption of a number of control measures. First and foremost among these is strict attention to sanitation in, and to the management of, the storage premises. Actual infestation may be reduced

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* Abstracted from Queensland Agricultural Journal, Vol. 64, Part 5. May, 1947. N. E. H. Caldwell, M.Agr.Sc., Horticulturist. Formerly Entomologist, Science Branch.

by the use of high and low temperatures and much good may be accomplished by spraying with appropriate insecticides and by the use of fumigants. These various control measures are discussed in the following paragraphs.

Sanitation and General Management.

The first essential in the control of stored products pests is strict attention to sanitation in all premises in which goods subject to attack by them are handled; all other control measures should be regarded as supplementary. Sanitation involves not only the maintenance of scrupulous cleanliness but also certain features of management aimed at eliminating, as quickly as possible, all breeding sites of the pests.

Most of the insects concerned in the infestation of stored products can live, and in many cases breed freely, in spilled goods and debris which may accumulate in cracks and crevices, in inaccessible corners, and under floors. Regular and thorough cleaning of the storage premises therefore is the basis of the control programme. If this is not attended to, contamination of fresh stocks begins as soon as they are taken into storage. In addition, the efficiency of other control measures, such as spraying and fumigation, is seriously impaired.

The construction of the buildings has an important influence on the question of sanitation. In a properly-designed structure the maintenance of the required standard of cleanliness is relatively simple; in a badly-designed building it becomes a difficult, if not an impossible, task. A good warehouse or store should have no dark, damp, inaccessible corners, and floors and walls should be free from cracks and ledges where debris may lodge. For this reason a smooth-finished concrete is the best type of construction. Any cracks in the structure should be filled with plastic bitumen or some comparable product, particular attention being paid to the junction between walls and floor. Regular applications of paint are helpful in sealing cracks in wooden walls and should be made with a spray gun, preferably after one of the periodical cleanings of the premises.

Walls, beams, and ledges should all be swept as well as the floors. Vacuum cleaners are particularly useful in cleaning corners and cracks and should be used in storage premises wherever practicable. Sweepings should be removed from the buildings at once and destroyed, preferably by burning. On no account should they be swept into a corner or under the steps or bagged and held on the premises for disposal later.

Certain commodities, such as bran, pollard and other stock foods, are more prone to heavy insect infestation than are highly processed goods. The risk of cross-infestation from the former is, therefore, great and accordingly stock foods should never be housed in the same premises as goods for human consumption. In the same way, even amongst the latter type of commodities, those particularly susceptible to insect attack, such as wholemeal flour, should, as far as possible, be isolated from other goods.

The correct rotation of stocks is an important phase of pest control work both in the home and in places where stored products are handled on a bulk scale. As a general rule, the oldest stocks on hand should be used first. Therefore, it is essential that a systematic method of stacking should be employed so that the oldest stocks are always readily accessible. All stocks, however, should be checked at frequent intervals and any which are unfit either for immediate consumption or for reconditioning should be removed at once and destroyed.

Since warm, moist conditions are usually favourable for the development of stored products pests, any measures designed to keep stocks cool and dry are worthwhile. In addition to the proper design and construction of buildings, such measures include the installation of fans, the use of dunnage under stacks to allow air circulation beneath them and a stack layout which permits maximum ventilation. Passageways should always be left between walls and adjacent stacks and between the several stacks. These passages should preferably be wide enough to permit a man to walk along them.

Control by Heat Treatment.

Heat can be used to control some insect pests and may, in certain cases, be applied easily and cheaply for this purpose. A high degree of heat is not required because most insects are killed if they are exposed to a temperature of about 125°F. for a few minutes. The chief difficulty in the application of this control measure lies in ensuring that the whole of the infested environment reaches the desired temperature, special provision being necessary to achieve this result. Even entire buildings may be heat-treated satisfactorily, especially in hot weather, provided they are well-built and specially equipped with a network of steam pipes for raising the temperature.

Heat is used to kill insects in a wide range of processed foodstuffs for which purpose specially constructed rooms are employed. These are fitted with controls to give a constant temperature of about 130°F. and the goods can be held in them until a uniform temperature is attained throughout each package.

In the home, small quantities of foodstuffs can be heated in ovens by spreading the material on trays in layers not more than two inches deep. By the time the surface temperature has reached about 170°F. the centre of the layer should be about 125°F. In gas ovens, this can usually be attained by keeping the flame as low as possible, turning off the gas when the temperature reaches 180°F. and then leaving the material in the oven with the door closed for half an hour. With the aid of a thermometer this treatment can be simply managed in any type of oven but, even in the absence of such an instrument, much can be done by the exercise of a little care. With a flour a temperature above about 170°F. should be avoided, as the baking quality may be seriously impaired by higher temperatures.

With most other products it is usually sufficient to ensure that charring does not take place. Frequent stirring will greatly assist uniform heating and reduce the risk of scorching.

Low Temperature Control.

Cold also may be employed at times as a pest control measure. At moderately low temperatures—40°F. to 55°F.—most foodstuff pests lie dormant and damage in infested goods may be arrested by storage at these temperatures. Several weeks of storage under such conditions will kill many insects. Comparatively short exposures to temperatures below freezing point are also fatal to many species.

Control by Spray Applications.

Sprays of various kinds find a place in the control programme for stored products pests. Most of the commoner sprays employed for this purpose must come in contact with the insects to be controlled and good results can be obtained from their use only if the premises in which the goods are stored are kept clean. Accumulations of spilled stock and debris will frequently protect any insects in them from the sprays and thus impair the efficiency of the whole operation. Due precautions also must be taken to ensure that flour and other susceptible commodities are not tainted by the odour of the spray used.

A fuel oil such as dieselene or some similar product may be sprayed liberally on floors and walls, particularly in grain sheds or other buildings where grains and stock foods are stored. Dunnage also should be treated after being taken up and brushed down. No commodities liable to absorb odours should be allowed to remain in the sprayed section while treatment is in progress and the whole building should be thoroughly aired for at least 24 hours before goods are stacked on the treated area. Liberal treatment with such an oil or even a cruder product is also advisable beneath steps and landing stages, and in other places outside the building where debris accumulates.

Sprays containing a pyrethrum extract and D.D.T. in an oil base, with or without other organic insecticides, are a valuable aid in suppressing stored products pests, notably moths, though they also have a considerable effect on beetles and some other species. Normally these sprays are available as proprietary fly mixtures. They depend for their action not only on their ability to kill many insects when sprayed directly on them but also on the fact that some species, principally moths, are killed if they come in contact with adequately-sprayed surfaces, such as walls of rooms and outsides of cases, even some considerable time after treatment.

Sprays must be applied in an atomised form. All walls and outside surfaces of containers—where accessible—should be sprayed at weekly intervals. When stacks of cases, for instance, are broken during the ordinary working of the store and fresh surfaces exposed, those surfaces

should be treated on the same day. Small hand atomisers are satisfactory for domestic use but for the adequate treatment of warehouses and their contents a power-operated, compressed-air plant operating a gun of the paint-spray type is necessary.

Many fly sprays have a kerosene base and hence are liable to cause tainting of certain commodities. Where the oil base is odourless the risk of tainting is completely eliminated. Unless it is known that an oil of the latter type has been employed in their manufacture, sprays should not be applied directly to the outside of absorbent containers such as sacks.

Fumigation Control Measures.

The use of fumigants in the control of pests of stored products may be discussed conveniently from three aspects, namely (1) fumigation of buildings, (2) fumigation of products in stores and (3) fumigation of products on the farm. In connection with fumigation of stored products, whether in a warehouse or on a farm, it must be remembered that, while efficient fumigation may destroy all insects present at the time of treatment, it will not prevent reinfestation. Fumigated products therefore must be stored in insect-proof containers or on premises as free from infestation as possible. The latter point emphasises once more the importance of sanitation.

Fumigation of Buildings.

The treatment of buildings by fumigants is usually a rather difficult and costly operation and should be undertaken only when simpler measures have failed to keep insect pests in check. Fumigation is not a substitute for routine hygienic measures and, as with spraying, it should always be preceded by a thorough cleaning of the whole premises. Successful treatment is possible only when the buildings can be made reasonably airtight. This is usually difficult to achieve and in poorly-constructed buildings may be almost impossible. The whole operation of fumigation of buildings should be undertaken only by thoroughly trained and experienced persons and is best done by firms which specialise in this type of work. The fumigant most commonly used in the treatment of buildings is hydrocyanic acid gas, which is very poisonous to human beings and animals and must be handled with the greatest care.

Fumigation of Products in Stores.

Stored products may be fumigated in several ways, depending on the type and quantity of material to be treated and on the facilities which are available.

Vacuum chamber fumigation represents the most highly specialised method of treatment but the facilities required for its adoption are rather elaborate and are not generally available. It necessitates the provision of a specially-constructed steel chamber or vault which is capable of withstand-

ing external atmospheric pressure when exhausted of air. After the chamber has been filled with the commodities to be treated, much of the air which it contains is pumped out and replaced by the fumigant. Vacuum fumigation has the three-fold advantage of high efficiency, rapidity of treatment, and economical use of the fumigant. As compared with the 24-36 hours required for treatment by other methods, vacuum fumigation of some commodities may be carried out in as short a period as 90 minutes. Much less fumigant is used than is required normally for treatment by any other method. Vacuum fumigation is particularly valuable for the treatment of tightly-packed goods such as flour and cased dried fruits, which are difficult to deal with by other methods, and also for perishable commodities which must be handled quickly. The fumigants commonly employed in vacuum chamber treatment are ethylene oxide and ethylene dichloride.

Atmospheric chamber fumigation, in which treatment is carried out at normal atmospheric pressure in air-tight buildings or rooms, is used extensively with many types of commodities. A suitable chamber may be constructed fairly cheaply using a non-porous material, though considerable care must be taken to ensure that it is as gas-tight as possible. Provision should be made in such a chamber for the circulation of the gas during fumigation and for removing it after treatment and fittings should be provided for the introduction of the fumigant. In atmospheric chamber fumigation the materials generally used are hydrocyanic acid gas, carbon bisulphide, methyl bromide, ethylene dichlorides and, for some special purposes, ethyl formate.

Fumigation of Products on the Farm.

Bin fumigation is the method most suitable for use on the farm. It involves the treatment of commodities, usually in comparatively small quantities, in some suitable container such as a tank, drum, or well-constructed box which is reasonably air-tight. The goods to be fumigated are placed in the container, the fumigant—which must be of the heavier-than-air type—is then introduced, and the top of the bin is closed with a tight-fitting lid or with a thick layer of canvas or sacking.

Grain, either loose or in sacks, can be fairly satisfactorily treated with a heavier-than-air fumigant under a tarpaulin or other type of covering weighted down at ground level. Rubberized sheets, if procurable, are the best type of covering, but any closely-woven fabric may be used. Success with this method will be achieved only if the floor on which the grain is resting is solid and thus reasonably gas proof.

Carbon bisulphide, one of the oldest fumigants, is still the most suitable for use on the farm and satisfactory results can be obtained with it in bin fumigation, or fumigation under tarpaulins or other coverings. This substance is a heavy liquid with an unpleasant odour. It is highly inflammable and should not be exposed near naked lights, electric switch gear, or hot pipes. When fumigating with it the liquid is poured into

shallow containers or on to several layers of bagging on top of the material being treated. The liquid vaporises and the gas, being heavier than air, sinks towards the bottom of the container, which should be left undisturbed for 36 hours, except in the case of certain seeds, such as cowpeas and related varieties, when only 24 hours' exposure is considered desirable. At the end of the necessary period, the container is opened and the contents aired thoroughly.

The dosage rate in carbon bisulphide fumigation depends on the degree of air-tightness of the container being used. In thoroughly gas-tight tanks and drums, 4 to 5 lb. of carbon bisulphide to every 1,000 cubic feet of container is sufficient. Thus a box measuring 4 feet by 3 feet by 2 feet—24 cubic feet—would require 2 oz. of fumigant if used at the rate of 5 lb. per 1,000 cubic feet. With less gas-tight containers the dosage must be increased until, for treatment under tarpaulins, it should be as high as 15 lb. per 1,000 cubic feet. Best results are obtained at high temperatures and, where possible, fumigation with carbon bisulphide should be avoided when the temperature drops below 70°F.

The risk of tainting foodstuffs with this fumigant is small, except perhaps with some of the more oily products such as nut meats, and airing after treatment is normally sufficient to dissipate any residual odour of the fumigant.

For the present, it appears that carbon bisulphide will continue to fulfil farmers' fumigation requirements. It may be, however, that as they become available in a suitable form, other materials will also be used on the farm for the control of stored products pests.

One other method of treating small quantities of seeds may be used by farmers when these cannot be stored in insect-proof containers and when facilities for fumigation with carbon bisulphide are not available. This method involves adding a mixture of naphthalene and paradichlorobenzene to the bags of seeds. Both these substances are white, crystalline solids, each with a characteristic odour, which vaporise on exposure to the air. The mixture is both toxic and repellent to insects; it kills those already present in the seed and gives a considerable degree of protection against reinfestation for some months. Equal parts by weight of the two substances are thoroughly mixed and then added to the seed at the rate of one to one and a half pounds to each bushel of the material to be protected. The paradichlorobenzene and naphthalene may either be mixed with the seed or distributed evenly through it in small cloth bags, each containing about one half pound of the mixture. As paradichlorobenzene vaporises much more rapidly than naphthalene, any residual crystals will probably be pure naphthalene. These are available for further use if the cloth bag method of distribution has been employed but the necessary amount of paradichlorobenzene, of course, must be added. Grain treated with this mixture retains a characteristic taint and should not be fed to stock.

Notes and Comments.

Malayan Agricultural Services Association.

Representatives of the Field Branch from all parts of the Malayan Union and members of the Research and Education branches of the Department of Agriculture gathered in Kuala Lumpur on Sunday, August 3rd, 1947, to form a Malayan Agricultural Services Association to provide organised and representative liaison between Government and the Junior Agricultural Staff.

The following office bearers for 1947 were elected at the inaugural meeting:—President, Tuan Haji Abdul Wahid, Soils Division; vice-presidents, Che Jafaar bin Mampak, Trengganu; Che Kamarudin bin Bahar, Entomological Division; Tuan Haji Abdul Rahman, Johore; hon. secretary, Che Mohd. Rashid, College of Agriculture; hon. treasurer, Che Ahmat Indot, Soils Division; Committee members, Che Shaffie bin Mohamed Taib, Central Experiment Station, Serdang and Che Ahmad bin Mohamad Said, Field Branch, Serdang, two representatives from Pahang, Johore and Perak and one from the States or Settlements (to be elected); Hon. Auditors, Che Omar bin Buyong, Chemistry Division and Che Mohd. Tamin bin Yeop, College of Agriculture.

Importation of Goats.

The Department imported six, male stud-goats in April of this year, from England. These are stationed at the Central Experiment Station, Serdang, and have been available for stud purposes free of charge.

It is now intended to station one of these goats—a British Saanen—at Kota Bahru, Kelantan, while another—a British Alpine—will be sent to Malacca. One British Toggenburg and one British Saanen are at present being retained at Serdang.

These goats are large animals of a high-milk producing strain, and those who are interested in goat keeping, and wish to obtain the services of these animals, are requested to communicate with the State Agricultural Officers in Kelantan or Malacca, or the Agricultural Officer in charge of the Central Experiment Station, Serdang.

Malayan Agri-Horticultural Association's Exhibition, 1947.

The Eighteenth Malayan Exhibition organised by the Malayan Agri-Horticultural Association was held at Coronation Park, Kuala Lumpur, during the 2nd., 3rd., and 4th. of August, in temporary buildings specially erected for the occasion.

Coronation Park, situated between Birch and Davidson Roads, offered ample space for the Show with parking space for vehicles, cars and cycles. The excellent lay-out of the buildings provided continuous cover for visitors in the event of inclement weather.

Although heavy rain, which fell during the three afternoons prior to the opening date, adversely affected the ground surface to some extent, the high elevation of the Park with its concomitant good drainage provided conditions for the rapid drying of the grounds, and little inconvenience was caused to visitors and exhibitors during the period of the Exhibition when the weather improved. There was an attendance of nearly 83,000 people, about 68,000 of whom paid for admission. Free admission was granted to school children and exhibitors. The Exhibition was the largest staged in the history of the Association.

In requesting His Excellency the Governor, Sir Edward Gent, K.C.M.G., D.S.O., O.B.E., M.C. to open the Exhibition, the President of the Association, Mr. S. B. Palmer, stressed the importance of growing more food, mentioning that any information gained at the Exhibition which would enable the public to increase local food crops, even by a small percentage, would make the holding of the Exhibition well worth while. He also appealed to the public to give more support to the Association.

His Excellency, in his speech, pointed out that the Government had given a lead for the people to follow, and urged padi growers to retain from their crops only what they reasonably required for their own consumption, and for seed purposes, and to sell the surplus to the Government.

The Agricultural Section.

The Agricultural Section comprised the following groups:—padi and rice, food crops and products, beverages, sugar, canned goods, spices, tobacco, arecanuts, fruits, vegetables, oils and fats and essential oils.

A bench space of 720 feet long by 4 feet wide was required to stage the entries, which were housed in a building 120 feet by 50 feet.

The collaboration of State Agricutural Officers throughout the Malayan Union in organising the selecting of competitive exhibits and forwarding them to the Show assisted greatly in raising the quality and number of entries.

The Padi Section.—Despite the high price of rice this section was fairly well filled with entries which necessitated the allocation of 120 feet by 4 feet of bench space. Entries were received from all large rice-growing States of the Union except Kedah and Kelantan.

The quality of the padi entered was superior to that shown at the 1946 Exhibition but not, in general, up to the standard reached before the war.

It is interesting to record that Enche Mat Kassan bin Kasboleh a prize winner at the 1946 Exhibition used this prize padi as seed for his 1947 crop and succeeded in winning the President's silver cup for the best exhibit in the Show. Prizes were fairly evenly distributed amongst all the States competing.

It was not considered opportune to reorganise the " All Malayan Padi Competition " this year although the shield presented for this competition has been recovered by the Association since the liberation of Malaya.

The Fruit Section.—Non-seasonal fruits were well represented especially in the citrus and banana classes, but the entries in the seasonal classes were very poor as a result of the abnormally wet weather which was experienced in most States in January and February. This had the effect of delaying the main fruit harvest, which is normally in July and August, for 3 to 4 months. In consequence a great many entries consisted of unripe fruits, which made the task of the Judges very difficult particularly in the classes for Chiku and Mango. The outstanding exhibits in these classes were the King Oranges, True Oranges and Yellow Rambutans.

Oils and Fats.—These were fairly well represented although the number of entries did not come up to expectations. The classes for soaps were better filled than last year but it would appear that the restricted supplies of caustic soda are adversely affecting the small-scale manufacture of soap.

Classes for prepared ginger are suggested to encourage the cultivation of this crop as an intercrop with pineapples on peat soils.

The copra exhibits were few and disappointing in quality, indicating that the pre-war work by the Department of Agriculture, in the education of small holders in copra drying has been forgotten, or that the facilities to make first grade copra were destroyed during the war. The indications are that small holders again need instruction on copra drying by lectures and demonstrations. It costs less in the long run to produce good copra in an efficient kiln which can be built at little extra expense. Demonstrations and lectures have been recommenced by the Department of Agriculture in coastal coconut areas, using a prefabricated kiln with a capacity of 400 nuts at one loading, which can be assembled and dismantled at short notice and used at any desired centre.

Vegetables.—This class occupied a bench space 240 feet by 4 feet and almost all the classes were represented, those for leaf vegetables being particularly good. Leaf-mustard, and cabbage exhibits from Chinese market gardeners were in great number and contained some fine specimens.

The entries for collections of vegetables were few in number but the exhibits were of good quality.

Beverages.—These were well supported by entries of fair to good quality lowland teas; the classes for various grades of black tea attracted very few entries—The coffee exhibits were of fair to good quality.

Tobacco and Arecanuts.—There were some entries of good quality produce in this Section but the classes were not well filled.

Department of Agriculture.

The exhibits staged in the pavilion of the Department of Agriculture were intended to bring into prominence and thereby stimulate interest in those crops which are of particular importance at the present time. In consequence they were fairly comprehensive and required a temporary building 50 feet by 40 feet with a bench space of 134 feet by 4 feet. In addition, a central kiosk and tables 20 feet by 3 feet were installed for the display of Departmental publications.

Exhibits of pigs, goats and poultry drawn from Agricultural Stations were also shown. These were adjacent to the area occupied by the Veterinary Department for competitive and exhibition cattle and buffaloes.

The central exhibit was padi, designed to illustrate improved methods of cultivation, varietal improvement, and off-season cropping of padi land. Samples of all the principal, Malayan varieties of wet-land padi, now undergoing selection or being studied in regional observations and varietal trials, were shown as padi and as hulled rice. These varieties included Mayang Ebos from Kedah, Kontor from Province Wellesley, Seraup from Krian, Anak Naga from Kelantan, Nachin from Malacca, and Serendah Kunirg from Negri Sembilan. In a few special instances the contrast between hulled rice and highly milled rice was also shown. The more important short-term, wet-land varieties and dry-land varieties were also represented. In addition, padi " blast " disease and vertebrate pests of padi and other crops were shown. In connection with the cultivation of rice and dry land crops a range of photographs was exhibited illustrating the current activities and results of mechanical cultivation.

The vegetative propagation of tea also was demonstrated i.e. the selection of mother bushes and the technique of establishing rooted cuttings.

In view of the growing importance of the rehabilitation of the pineapple canning industry, and the post-war transference of this crop to peat soils in preference to the pre-war practice of planting the crop on upland, undulating, quartzite areas, an exhibit was staged of plants grown on peat soils. The canning side of the industry was illustrated by an excellent series of photographic enlargements. There was also a display of canned fruits.

Hydroponics or the growing of crops in nutrient solutions attracted considerable interest. The exhibit showed the successful growth of several types of food crops in nutrient solution alone and in sand aggregates, irrigated constantly with nutrient solutions. This method of cultivation is still in the experimental stage in Malaya, but as the requisite chemicals become available it is hoped to continue investigations and to publish the results of experiments particularly for the benefit of those living in urban areas.

The bud-grafting of fruit trees was demonstrated to show the technique recommended for the successful propagation of durians and rambutans.

Growing plants of Manila hemp were shown along with cleaned fibre of excellent length and lustre and specimens of hand-made ropes. Ramie fibre plants were shown growing in pots.

The species and varieties of derris recommended by the Department were shown growing in tubs. There were also specimens of cleaned root and derris dust.

Profiles of typical Malayan soils were shown, including different types of quartzite, coastal alluvium and padi soils.

A wide range of tropical and temperate climate vegetables, grown at the Kuala Lumpur Experiment Station, were exhibited. These caused con-

Rice Exhibit at Malayan Agri-Horticultural Exhibition, August 1947.

siderable interest and many enquiries were received on the methods of cultivation necessary to achieve such results.

A range of produce from the Agricultural Station, Cameron Highlands was exhibited, comprising several grades of black tea, with a comprehensive collection of temperate climate vegetables; the exhibit also included graded eggs of the Rhode Island Red and White Leghorn breeds of poultry.

Twelve young boars and 12 young gilts with a stud boar of the Middle White breed of pigs were transported from Cameron Highlands in order to illustrate the class of pigs the Department was breeding for distribution in the country.

Pens of Rhode Island Red and White Leghorn pullets were shown with a cock of the same breed in each case. " Night Arks " of an approved design were also exhibited.

In order to demonstrate the Departmental policy of transmitting milking qualities and greater size to the progeny of local goats, bucks of the imported breeds British Alpine, British Saanen and British Toggenberg were shown. Notices inviting goat keepers to have their does mated to these bucks free of cost, were displayed.

A selection of Departmental publications, both English and Vernacular, was also exhibited and over 16,000 leaflets and pamphlets were distributed.

Export of Tea.

It is notified for information that there is no objection to the export of tea in reasonable quantities from the Malayan Union. Applications for licence, which should be made to the Comptroller of Customs in the ordinary way, will be favourably considered.

Report on Malayan Tea

Samples of tea grown at Tanah Rata Agricultural Station, Cameron Highlands, were forwarded to Messrs. Wilson, Smithett & Co., tea experts of London, who report that " all the grades sent were of very satisfactory manufacture, the flowery, brown, orange pekoe being of excellent appearance and true to grade." The report adds that " the clean, black leaf and bright attractive liquors would appeal to buyers and would meet with keen competition from London dealers and blenders."

The Malayan Nature Journal.

Students of nature will welcome the return of *The Malayan Nature Journal*, the first post-war number of which was published in July. The Journal covers a wide field of observation and includes articles on Malayan birds and cobras and the Malayan Slipper orchids .

The Malayan Nature Society attracted considerable attention before the war. Membership is open to all who are interested in the " natural " things of Malaya, and Mr. A. T. Edgar, the Secretary and Treasurer of the Society, is particularly anxious to increase the Asiatic as well as the European membership. Mr. A. T. Edgar's address is care of Mr. S. B. Palmer, Anglo-Oriental Building, Kuala Lumpur.

Review.

LATEX PRESERVATION, CONCENTRATION AND SHIPMENT.

Rubber Research Institute of Malaya: Planting Manual No. 4, 2nd Edition 1947, by J. H. Pidford. Price $2.00.

This publication replaces the original Manual No. 4 of 1932 by Bishop and Fullerton; as, since that time, there have been various new developments and an enormous increase in the export of latex. The present uncertainty in the rubber industry is leading many producers to look for new markets and to consider the export of their rubber in the form of latex rather than smoked sheet.

The author begins with a warning of the difficulties and disadvantages, including the loss of dry rubber, the paramount importance of uniformity, the close supervision, the special handling, packing and shipment.

It is then explained that, firstly, the estate must be suitable for latex production; the field latex should reach an adequate D.R.C. and its colour should be suitable. The behaviour of latex in the creaming process is unpredictable, and mono-clonal rubber may be very different from the average seedling rubber. The author proceeds to deal in detail with the technique, starting with latex in the field, where cleanliness and early preservation with ammonia are so important. Collection bulking and ammoniation are described, along with the final preparation of preserved field latex for export. Centrifugal concentration is next considered, by which means a cream of 60% D.R.C.* is obtained in a high state of purity. This concentrate after being made to absorb the requisite amount of ammonia is ready for export. The operation of the centrifugal machines needs careful control; an inevitable by-product is the skim which contains two-thirds of the original serum and about ten per cent. of the original rubber. In the past this skim might be disregarded, producing as it does an abnormal rubber and being troublesome to deal with. The recovery of this rubber is at present more financially imperative and various methods of so doing are described.

The concentration of latex by use of various creaming agents, and the restrictions created by patents in this field are treated in detail. The advantages of the method lie in the simplicity of equipment and operation, together with low costs and small loss of rubber in the serum. Against this are the sensitivity of the process to field conditions, with day to day variation, the difficulty of reaching 60% D.R.C. and the lower degree of purity; causes which lead to a market preference for centrifugal concentrate.

* Dry Rubber Content.

A brief mention is made of other concentration methods, which are not likely, at present, to be entertained by estate producers. One of these has been operated commercially, namely concentration by evaporation. In this process, the concentrate retains all the original serum solids, and unlike the product previously discussed finds different markets.

In a discussion of preservatives, the use of ammonia is shown to have been almost invariably practised despite search for more desirable substitutes. The advantages possessed by sodium pentachlorphenate are mentioned.

Packing and shipment of latex present numerous problems. Steel drums offer the simplest means, subject to difficulties in the matter of cleanliness and uniformity of contents. Bulk shipment is for the large producer and involves special installations for loading and unloading ships' tanks.

The market standards for latex are stated, and precisely explained, with instructions how to attain and maintain them and make the necessary tests to verify that the product conforms to standard. Lastly the author discusses patents as they affect the producers and gives a guide to the nature of all the known patents concerned with latex processing.

The Manual is thus a most valuable guide to those who are engaging in this branch of the rubber industry or may be contemplating entering it, but, as the author himself states, there are considerable gaps in the knowledge yet to be filled by research and development work.

T. A. B.

Departmental.

FROM THE DISTRICTS

Compiled by the Chief Field Officer from Monthly Reports of Agricultural Officers.

June, July and August, 1947.

The Weather.

There was little rainfall in most districts during the early part of June with hot dry conditions prevailing. Later heavy rainfall was recorded from many districts. On the Selangor coast the south wind began to blow during the last week of June. Some rain was experienced during the first week of July in most States, but after this the weather became hot and dry and continued fine in Kedah, and parts of the east coast, during August, with practically no rain during the greater part of the month. Elsewhere some rain was experienced, with exceptionally heavy rain in parts of Negri Sembilan.

Crop Reports.

Foodcrops and Vegetables.—The census of acreage of essential foodcrops in Malacca for the second quarter revealed a net increase of approximately 2,000 acres bringing the total area under cultivation to 11,087, the highest recorded for the year. Substantial increases were shown in market-garden vegetables, tapioca, sweet potato, groundnuts and maize; the increase in the acreage under maize being directly attributable to assistance in the matter of seed provided by the Department of Agriculture.

Reports from Cameron Highlands state that the output of vegetables was fairly steady at about 400 piculs per day. A greater variety in the vegetables was noted in gardens, and seasonal extension of tomato growing is taking place. Such crops as green pea and celery are being grown, but the major crops are mainly cabbage and leeks. The output of vegetables from the Highlands during August is estimated to have been 750 tons.

In the Seremban and Port Dickson districts of Negri Sembilan, increased planting of root crops was noted during July. Excellent crops of mustard, kale and lettuce were harvested in local market gardens, and large quantities of chilli, bitter gourd, wax gourd and pumpkin were exported from the State.

In the Rembau district there is a holding of 3 acres almost entirely planted with bitter cucumber; the yield is stated to be 6 piculs of fruit per day and for any one crop this yield is maintained for about three weeks. The produce was sold during July at $30 per picul. It is proposed to carry on the cropping of the area with bitter cucumber for about 2 years unless it becomes unprofitable. Cultivation of bitter gourd is still extending in Selangor, and there was at least 50 acres under sole cultivation with this crop during the month of August.

Wet Padi.—Harvest was completed in July at Dusun Tua, Selangor, where it is reported that the use of bat guano gave a 10 to 15 per cent. increase of crop on the poorer plots, but did not materially affect crops on the better land. Ten trial plots with bat guano were laid down during August in padi fields in Ulu Selangor in this season's planting.

In the Segamat district of Johore, 4,561 acres of wet padi were planted by July; of this area 1,572 acres were planted by Chinese. In the same district, Chinese cultivators are continuing to clear new jungle areas which should be ready for short-term, off-season padi after the present main-crop harvest is over.

In Kelantan, harvesting of off-season Taiwan padi was in progress during July. A series of crop-cutting tests was undertaken, and it appears that the strain of Taiwan padi grown is tolerant to a high degree of brackish water. In sandy padi fields, only 200-400 yards from the beach, an average yield of 540 gantangs padi per acre from thirteen cutting tests was obtained while further inland the yield averaged 195 gantangs per acre. At Kuala Pak Amat, on land that had been abandoned owing to the salinity of the water, yields of 400 gantangs of padi per acre of this Taiwan strain have been recorded.

Throughout the State of Negri Sembilan, there are many scattered areas of padi on temporary occupation licence, and planted on estate land, and, recently, thorough investigation in the Seremban and Coast districts by the Staff of the Department has revealed that there are 480 acres of wet padi planted on temporary occupation licence. A number of districts have not yet been investigated and when the whole State has been covered it is estimated that a further 1,500 acres may be recorded.

In Malacca, the Departmental scheme for the distribution of bones was continued, and 2,898 piculs of bones have so far been distributed to padi cultivators. At local rates of application there is sufficient for 5,796 acres. Without this assistance, cultivators would find difficulty in obtaining their requirements as local dealers charge high prices.

Rubber.—In general, prices showed a further slight decline during the past quarter and, for this reason, and because alternative employment was available in the padi fields, many small-holders discontinued tapping. In Selangor, Chinese tappers are finding more lucrative employment in the tin mines.

Coconuts.—The price of copra remained steady and there was a great demand for nuts during the fasting month. In Kelantan, an increased production of coconut sugar was reported.

Miscellaneous Crops.—The tobacco crop in Kelantan and Trengganu is very satisfactory and harvesting is in progress. Fruit production in Negri Sembilan has been excellent and bananas in particular have proved to be a very paying crop. Patchouli is attracting attention in Johore.

Poultry.

Interest in poultry keeping is increasing. The hatcheries in Malacca maintained their output despite a drop in production during July due to shortage of feeding stuffs. The retail price of 25-30 cents for ducklings and chicks remained steady and large numbers of fresh eggs from Johore were sold to the Singapore hatcheries. A new poultry farm has been started up by a Malay at the 27th mile, Johore Bahru—Pontian road and another, in Penang, which is utilizing imported Australian stock. In Selangor, the poultry farms in Klang and Kuala Lumpur are expanding.

Miscellaneous.

Bat Guano Distribution.—Distribution of Bat Guano to padi planters in Kedah and Perlis continued under the direction of the State Agricultural Officer. Up to the end of August, 3,085,080 gantangs had been distributed. Distribution is also beginning in Kelantan.

Destruction of Animal Pests.—Reports from all districts refer to successful measures taken against Wild Pigs. Record numbers were shot by hunters in Malacca and Kelantan during August. In Perak it is hoped completely to eliminate this pest when further guns and ammunition are available.

Fresh-Water Fish.—A good trade is being developed in Selangor in "Haruan", an excellent fresh-water fish. Up to a picul a day is being exported.

DEPARTMENTAL NOTES

Mr. C. W. S. Hartley, Agricultural Officer, has been appointed to officiate as Agricultural Officer-in-Charge Central Experiment Station, Serdang, with effect from 16th August, 1947.

Mr. H. J. Simpson, Agricultural Officer, has been appointed to officiate as Agricultural Officer, Penang and Province Wellesley, with effect from 16th August, 1947.

Mr. O. M. Lee, Agricultural Officer, returned from leave on 15th July and assumed duty on 16th July as Agricultural Officer (attached) College of Agriculture, Malaya.

Mr. F. C. Cooke, Canning Officer, has been granted 155 days leave on full pay with effect from 13th September, 1947.

Mr. P. V. Ormiston, Agricultural Officer, Johore North, went on transfer to Cameron Highlands on 22nd September, 1947.

Mr. B. G. A. Lowe, Agricultural Officer, Cameron Highlands, went on transfer to Johore Central on 23rd September, 1947.

Statistical.

MARKET PRICES.

September 1947.

Rubber.—During July the Singapore price of rubber advanced from 26 cents per lb. at the beginning of the month to 31½ cents per lb. at the end of the third week but dropped to end the month at 29⅝ cents per lb. The decrease in price continued during August and the month closed with the price at 28 cents per lb. This price remained constant for the first two days of September after which the price advanced slowly to close at 32⅜ cents per lb. on the last day of the month.

The average prices paid for small-holders' rubber at three centres during the third quarter of 1947 are given in Table I.

Table I.

Average Weekly Prices Paid by Local Dealers for Small-Holders' Rubber, July-September, 1947.

(Dollars per picul of 133⅓ lbs.)

Grades	Ipoh, Perak.			Kuala Pilah, Negri Sembilan.			Batu Pahat, Johore.		
	July	Aug.	Sept.*	July	Aug.	Sept.*	July	Aug.	Sept.*
Smoked Sheet ..	33.40	32.50	34.23	32.87	32.44	33.67	28.41	29.46	31.65
Unsmoked Sheet ..	28.00	26.50	27.67	27.44	27.44	29.84	24.08	27.16	28.29
Scrap ..	10.38	12.50	12.67	8.38	8.75	10.17	14.01	9.89	11.30

Transport from Batu Pahat to Singapore by lorry, excluding duty, $1.00 per picul.
* Average of prices for first three weeks of September only.

Table II.

Singapore Prices of Various Agricultural Products.

Product	September, 1947			August 1947	Average Price Jan.-Oct. 1941
	Highest	Lowest	Average	Average	
	per picul $	per picul $	per picul $	per picul $	per picul $
Copra:					
Sundried No. 1 ..	23.50	20.00	22.27	20.94	2.58
No. 2 ..	*	*	*	*	2.33
No. 3 ..	*	*	*	*	*
Coconut Oil ..	37.00	32.00	34.50	32.80	8.64
Coffee:					
Padang Bali No. 1 ..	93.00	85.00	89.50	102.30	*
No. 2 ..	90.00	81.00	85.39	97.30	*
Palembang No. 1 ..	65.00	57.00	60.65	58.20	18.07-19.91
Sourabaya New No. 1	70.00	70.00	70.00	74.20	19.13-21.02
Bali Old ..	*	*	*	*	*
Pepper:					
Muntok White ..	134.00	123.00	127.85	117.40	15.33
Lombong White ..	*	*	*	*	*
Sibu White ..	*	*	*	*	*
New Black ..	*	*	*	*	*
Old ..	*	*	*	*	*
Sarawak ..	130.00	121.00	125.00	115.3	*
Siam Black ..	*	*	*	*	*
Nutmeg:					
No. 1 ..	*	*	*	*	25.19
No. 2 ..	*	*	*	*	23.66
Cloves:					
Indian ..	43.00	40.00	42.13	42.9	*
Sumatra ..	50.00	46.00	47.00	51.5	*
Gambier:					
Rounds No. 1 ..	128.00	125.00	125.23	*	13.65
No. 2 ..	110.00	110.00	110.00	*	*
Cake ..	*	*	*	*	*
Sago Flour:	15.85	14.65	15.45	15.12	*
Lingga ..	*	*	*	*	*
Local No. 1 ..	*	*	*	*	*
No. 2 ..					
Tapioca Flour:					
Malayan No. 1 ..	29.00	29.00	29.00	28.80	*
No. 2 ..	26.00	26.00	26.00	25.80	*
Java ..	*	*	*	*	*

* Not quoted.

MALAYAN UNION PRODUCTION OF PALM OIL AND KERNELS.

(In long tons as declared by Estates)

Month 1947	Palm Oil	Palm Kernels
January	2,238.2	292.3
February	2,316.9	337.1
March	2,585.8	386.2
April	2,410.2	380.2
May	2,377.7	359.9
June	2,451.2	336.1
July	3,479.4	452.6
Total ..	17,859.4	2,544.4
Total May-December, 1946 ..	11,756.4	931.6 (Aug.-Dec.)
Total Jan.-Sept., 1941 ..	38,588.4	2,332.5
Total for the year 1940 ..	57,972.1	9,611.2

Stocks on estates as at 31st July, 1947, were: palm oil 2,056 tons, palm kernels 378 tons.

In July 33 estates (planted acreage 70,828.4 acres) were in production out of a total of 46 oil palm estates (planted acreage 77,981.4 acres).

MALAYAN AGRICULTURAL EXPORTS, FEB.-MAR., 1947.

Product	Net Exports in Tons.			
	Year 1940	Jan.-Oct. 1941	February 1947	March 1947
Arecanuts	43,915	24,633	1,844	258*
Coconuts fresh†	131,469†	178,404†	2,683†	3,055†
Coconut oil	69,446	65,045	4,185	3,268
Copra	9,004*	32,682*	1,885*	3,433*
Copra cake	1,215*	5,659*	360*	384*
Gambier, all kinds ..	821	489	78	93
Palm kernels	9,219	1,984	406	321
Palm Oil	56,091	44,406	2,090	12,226
Pineapples, canned ..	40,243	15,086	161	2
Rubber¶	547,202¶§	500,982¶§	50,003¶	58,782¶
Sago,—flour	2,525	1,752*	1,840	1,046*
„ —pearl	4,848	6,217	753	1,247
„ —raw	4,816*	4,400*	648*	842*
Tapioca,—flake ..	762	601	5	8
„ —flour ..	2,649*	4,310*	1,045	1,225
„ —pearl ..	17,004	15,164	Nil	562
Derris	1,258	998	52	70

† hundreds in number. * net imports. ¶ production.

§ Malayan Union and Singapore.

MALAYAN UNION RUBBER STATISTICS.

Estates of 100 Acres and over. Production July, 1947.

In Dry Tons.

STATE	PRODUCTION						STOCKS		PREPARED LATEX PRODUCTION	
	European	Chinese	Indian	Others	Total	Total Jan./July 1947	Beginning of Month	End of Month		
(1)	(2)	(3)	(4)	(5)	(6)	(7)				
Perak ..	4,709	399	230	25	5,363	32,890	4,478	4,520	Preserved field	
Selangor ..	5,433	436	99	8	5,970	35,308	5,143	5,157	Latex	877
N. Sembilan ..	4,144	298	135	110	4,687	28,511	3,266	3,206	Centrifuge Con-	
Pahang ..	1,248	610	99	—	1,957	12,416	1,424	1,553	centrate	1,472
Malacca ..	1,305	374	87	—	1,766	11,116	1,624	1,351	Revertex	175
Penang & P. Wellesley	400	74	4	—	478	2,716	412	415		
Johore ..	5,999	1,256	241	639	8,135	46,041	5,440	5,392		
Kedah ..	3,669	442	116	25	4,252	25,438	3,171	3,294		
Perlis ..	—	2	22	—	24	151	21	22		
Kelantan ..	471	61	—	23	555	2,920	548	581		
Trengganu ..	120	57	—	2	179	1,010	159	145		
Total ..	27,498	4,003	1,033	832	33,366	198,517	25,686	25,636		2,524

Notes:—1. Figures for production of prepared latex for export are included in the month's production figures, columns 2 to 6.

2. Production by estates of less than 100 acres for July, 1947, was estimated to be 20,407 tons. Total estimated small-holding production January to July, 1947, 166,115 tons.

3. Total latex production 1946, 5,223 tons. Latex production June, 1947, field latex 876 tons, centrifuge 1,245 tons revertex 133 tons.

4. Stocks on estates of less than 100 acres are not ascertained.

5. The above forms part of the July rubber statistics published by the Acting Registrar of Statistics, Malayan Union, at Kuala Lumpur, on 23rd August, 1947.

MALAYAN UNION RUBBER STATISTICS.

Acreages of Tappable Rubber Actually Tapped and not Tapped on Estates of 100 Acres and over for the Month ending 31st July, 1947.

STATE	Estimated Acreages of Tappable Rubber (9) + (11)	Acreage of tappable Rubber not tapped				Area of tappable rubber never been tapped (b)		Total Area not tapped (3) + (5) (c)		Total Area tapped during the month (c)		Area of tappable rubber rested under rotational systems (c)	
		On estates which have entirely ceased tapping		On estates which have partly ceased tapping (a)									
		Acreage	% of (3) to (2)	Acreage	% of (5) to (2)	Acreage	% of (7) to (2)	Acreage	% of (9) to (2)	Acreage	% of (11) to (2)	Acreage	% of (13) to (2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Perak ..	272,926	1,569	.6	40,988	15.0	11,843	4.3	42,557	15.6	230,369	84.4	22,122	8.1
Selangor ..	325,276	1,837	.6	41,030	12.6	12,527	3.9	42,867	13.2	282,409	86.8	16,120	5.0
N. Sembilan ..	256,658	3,866	1.5	56,599	22.1	21,888	8.5	60,465	23.6	196,193	76.4	16,195	6.3
Pahang ..	92,676	798	.9	17,287	18.6	8,265	8.9	18,085	19.5	74,591	80.5	5,033	5.4
Penang & P. Wellesley ..	28,045	1,628	5.8	3,174	11.3	892	3.2	4,802	17.1	23,243	82.9	5,803	20.7
Malacca ..	121,542	2,185	1.8	15,257	12.6	4,893	4.0	17,442	14.4	104,100	85.6	10,599	8.7
Johore (d) ..	458,200	9,897	2.1	94,266	20.6	31,120	6.8	104,163	22.7	354,037	77.3	31,800	6.9
Kedah ..	194,224	669	.3	32,454	16.7	12,881	6.6	33,123	17.0	161,101	83.0	21,283	11.0
Kelantan ..	29,916	215	.7	4,298	14.4	1,050	3.5	4,513	15.1	25,403	84.9	7,196	24.1
Trengganu ..	15,028	388	2.6	6,079	40.4	1,232	8.2	6,467	43.0	8,561	57.0	797	5.3
Perlis ..	1,837	—	—	372	20.3	164	8.9	372	20.3	1,465	79.7	290	15.8
Total ..	1,796,328	23,052	1.3	311,804	17.3	106,755	5.9	334,856	18.6	1,461,472	81.4	137,238	7.6

Notes:—(a) Area out-of-tapping on estates which have partly ceased tapping refers to areas definitely being rested and excludes area on any tapping round.

(b) The acreage shown in column (7) is included in columns (3) and (5).

(c) Areas of tappable rubber rested under rotational systems are not considered as out-of-tapping and therefore columns (11) and (12) include columns (13) and (14) respectively.

(d) Registered estates only.

(e) This table was published by the Acting Registrar of Statistics, Malayan Union, on 25th August, 1947.

MALAYAN UNION RUBBER STATISTICS.

Summary of Stocks, Production, Imports and Exports of Rubber, July, 1947.

In Long Tons, Dry Weight.

		Tons	Tons
STOCKS (30th June)			
Estates	..	25,686	
Dealers	..	52,190	
Ports, awaiting shipment	..	9,507	87,383
IMPORTS	..		2,889
PRODUCTION			
Estates	..	33,366	
Small-holdings (estimated)	..	20,407	53,773
Total	..		144,045

		Tons	Tons
EXPORTS			
Foreign	..	29,297	
Local (to Singapore)	..	22,336	51,633
LOCAL CONSUMPTION	..		143
STOCKS (31st July)			
Estates	..	25,636	
Dealers	..	58,958	
Ports, awaiting shipment	..	7,675	92,269
Total	..		144,045

Note:—The above forms part of the July rubber statistics published by the Acting Registrar of Statistics, Malayan Union, at Kuala Lumpur, on 23rd August, 1947.

MALAYAN UNION PADI STATISTICS.

Area of Land Planted and Yields of Padi Season 1946—1947.

STATE	Wet			Dry			Total Wet and Dry Padi	
	Acres	Gantangs	Average Yield (Gantangs per Acre)	Acres	Gantangs	Average Yield (Gantangs per Acre)	Acres	Gantangs
Perlis ..	36,640	10,320,000	281	60	6,200	103	36,700	10,326,200
Kedah ..	236,820	61,820,000	261	4,255	373,500	88	241,075	62,193,500
Kelantan ..	133,722	23,308,647	174	29,813	2,982,639	100	163,535	26,291,286
Trengganu ..	34,876	5,635,617	161	18,182	2,479,480	136	53,058	8,115,097
Penang & P.Wellesley ..	37,736	8,840,280	234	590	79,275	134	38,326	8,919,555
Perak ..	106,140	17,753,000	167	15,040	1,337,000	89	121,180	19,090,000
Selangor ..	34,520	8,682,800	252	4,890	457,100	93	39,410	9,139,900
Pahang ..	39,787	7,224,800	182	4,409	380,180	86	44,196	7,604,980
N. Sembilan ..	29,612	5,807,970	196	36	1,035	29	29,648	5,809,005
Malacca ..	30,611	5,688,820	186	120	23,700	198	30,731	5,712,520
Johore ..	12,142	966,611	80	3,449	170,621	49	15,591	1,137,232
Total ..	732,606	156,048,545	213	80,844	8,290,730	103	813,450	164,339,275

164,339,275 Gantangs of Padi = 246,756 tons of Rice.

(Conversion: 666 Gantangs of Padi equals 1 ton of Rice).

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1947.

Locality.	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Mean of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day. Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m.m.	ins.								
Ipoh, Perak ..	92.4	72.5	82.5	97	69	86	77			8.73	221.7	3.54	13	12	3					
Port Swettenham, Selangor	89.7	72.0	80.9	94	69	84	75	84.2	84.8	6.05	153.7	2.75	13	10	1					
Sitiawan, Perak ..	88.7	72.6	80.7	91	69	83	75			4.77	121.2	2.06	10	9	2	1				
Kuala Lipis, Pahang ..	89.8	72.7	81.3	93	70	84	75	83.7	85.3	3.66	93.0	0.90	10	8		22				
Kuantan, Pahang ..	90.0	72.1	81.1	94	70	82	75			2.54	64.5	1.23	10	5		1				
Bayan Lepas, Penang ..	87.7	74.5	81.1	90	71	84	77			5.00	127.0	1.42	10	10						
Malacca ..	85.9	74.7	80.3	89	72	80	80			2.32	58.9	0.51	11	11	1					
Mersing, Johore ..	87.2	72.5	79.9	91	70	79	76			4.46	113.3	2.34	8	7	15					
Alor Star, Kedah ..	88.9	74.0	81.5	93	71	78	77			8.89	225.8	2.99	16	15		1				
K. Trengganu, Trengganu	89.1	73.3	81.2	92	70	83	75			1.76	44.7	1.27	7	4	2					
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft. ..	73.7	62.9	68.3	78	60	68	65	71.1		5.60	142.2	2.12	12	10		6				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	73.4	54.7	64.1	78	47	69	60	69.8		9.30	236.2	2.88	17	16		1				

NOTICE.

Department of Agriculture, Malayan Union.

The Director of Agriculture invites those interested to visit the Central Experiment Station and the College of Agriculture, Serdang, and also the other Experiment Stations, Agricultural Stations, Padi Experiment Stations, and Padi Test Stations, of the Department in various parts of the Peninsula.

Intending visitors to the Central Experiment Station should communicate with the Senior Agriculturist. Visitors' days at the Central Experiment Station are the first and third Wednesdays in each month. Intending visitors to the College of Agriculture should communicate with the Principal.

The Central Experiment Station and the College of Agriculture are situated about 14 miles by road from Kuala Lumpur and 3 miles from Serdang Railway Station.

Stations are listed below together with the addresses of officers to whom enquiries should be sent.

AGRICULTURAL STATIONS.

Kedah.

Gajah Mati Agricultural Station.—*State Agricultural Officer, Kedah, Alor Star.*

Kelantan.

Central Experiment Station, Kota Bharu.
Bachok Agricultural Station.
Pasir Mas Agricultural Station.
Melor Experiment Station.
State Agricultural Officer, Kelantan, Kota Bharu.

Penang and Province Wellesley.

Ayer Itam Agricultural Station.
Bukit Mertajam Agricultural Station.
Agricultural Officer, Penang and Province Wellesley, Butterworth.

Perak,

Simpang Lima Agricultural Station.
Selama Agricultural Station.
Agricultural Officer, Perak North, Taiping.
Kuala Kangsar Agricultural Station.
Ayer Tawar Agricultural Station.
Agricultural Officer, Perak Central, Kuala Kangsar.
Degong Agricultural Station.
Tanjong Malim Fruit Nursery.
Agricultural Officer, Perak South, Teluk Anson.

Selangor.

Central Experiment Station, Serdang.
Experiment Station, Kuala Lumpur.
Coconut Experiment Station, Port Swettenham.
Senior Agriculturist, Central Experiment Station, Serdang.
Cheras Agricultural Station.
Telok Datoh Agricultural Station.
State Agricultural Officer, Selangor, Kuala Lumpur.

Pahang.

Kuala Lipis Agricultural Station.
Raub Agricultural Station.
State Agricultural Officer, Pahang, Raub.
Temerloh Agricultural Station.
Malay Agricultural Officer, Pahang South, Temerloh.